U.S. Army Corps
of Engineers
St. Paul District

Emergency Plan
for
Pokegama Dam and Reservoir

March 1987

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This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies which, while rare, could occur in the operation of Pokegama Dam.

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TO	FROM	DATE	CMT 1
See Attached Distribution	CENCS-ED-M	15 April 1988 Blackstone/429	

Copies of the completed emergency plans for Pokegama Dam is enclosed for your reference. This report implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for identifying, mitigating, or responding to various types of emergencies which, although unlikely, could occur during the operation of the dam.

Please contact me at (612) 220-0429 with questions or comments or to request additional copies.

1 Encl

JOHN F. BLACKSTONE
Project Manager

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Dated
18 April 1988

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605-1592

REPLY TO
ATTENTION OF

28 JAN 1988

CENCD-ED-WH (1130-2-419)

MEMORANDUM FOR: Commander, St. Paul District, ATTN: CENCS-ED-M

SUBJECT: Emergency Plans for Gull Lake Dam, Sandy Lake Dam, Pokegama Dam and Leech Lake Dam

1. We have reviewed the emergency plans for the subject dams. The plans are approved subject to preparation of revised pages which address the following comments.

a. Provide a revised contact list internal to the Corps of Engineers. The contact list should include the position of each person to be contacted.

b. Provide a list of the equipment and materials which are available at each site for use in an emergency.

c. Revise the plates which present the downstream profiles resulting from dam failure to include the profile for the flood of record and for failure during normal full pool.

2. References:

a. CENCS-ED-M Memorandum of 18 September 1987, subject: Emergency Plans for Gull Lake Dam and Reservoir and Sandy Lake Dam and Reservoir.

b. CENCS-ED-M Memorandum of 18 June 1987, subject: Emergency Plans for Pokegama Dam and Reservoir and Leech Lake Dam and Reservoir.

FOR THE COMMANDER:

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1135 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101-1479

REPLY TO ATTENTION OF
NCSED-M (350-3-2A)

18 JUN 1987

SUBJECT: Emergency Plans for Pokegama Dam and Reservoir and Leech Lake Dam and Reservoir

MEMORANDUM FOR: Commander, North Central Division, 536 South Clark Street, Chicago, Illinois 60605-1592

1. Subject reports are submitted in accordance with Engineer Regulation 1130-2-419.

2. These reports implement the Corps program to prepare emergency plans for all Corps dams. It provides a guide for identifying, mitigating, or responding to various types of emergencies, which, although unlikely, could occur during the operation of Pokegama and Leech lakes.

3. Please note that we have provided preliminary copies of the final emergency action plans because we are awaiting plan approval before printing copies for distribution. We request that you return the enclosed plans, and we will provide copies of the final plans after they have been approved and printed.

JOSEPH BRIGGS
Colonel, Corps of Engineers
Commanding

2 Encls
1. EAP, Pokegama
2. EAP, Leech Lake

EMERGENCY PLAN

FOR

POKEGAMA DAM AND RESERVOIR

PREPARED BY THE

ST. PAUL DISTRICT

U.S. ARMY CORPS OF ENGINEERS

MARCH 1987

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EMERGENCY PLAN
FOR
POKEGAMA DAM AND RESERVOIR

1. Introduction

Part of the land surrounding Pokegama Dam and Reservoir that would be inundated by the Probable Maximum Flood is not in Federal ownership. In addition, most of the land under Federal control is also public use land. The possibility therefore exists that high water levels could cause a hazard to life and property in the project area and surrounding lands. In addition, a failure of the dam or embankment during normal pool, low flow conditions could result in the sudden release of a large volume of water from the reservoir, which would cause a hazard to life and property in the project area and surrounding lands.

a. Purpose

This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies which, while rare, could occur in the operation of Pokegama Dam. Specific information on emergency actions to be taken is provided in the following appendices:

(1) APPENDIX A, Emergency Identification Subplan.

(2) APPENDIX B, Emergency Operations and Repair Subplan.

(3) APPENDIX C, Emergency Notification Subplan.

(4) APPENDIX D, Inundation Map Package.

b. Applicability

The emergency plan is applicable to all Corps elements and field offices concerned with operation of Pokegama Dam.

c. References

(1) Flood Emergency Plans, Guidelines for Corps Dams, Hydrologic Engineering Center, Water Resources Support Center, Davis, CA, June 1980.

(2) Structural Stability Evaluation, Pokegama Dam, C.E. Pace, R.L. Campbell, G.S. Wong, Structures Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., September 1980.

(3) Federal Guidelines for Dam Safety, Prepared by Ad Hoc Interagency Committee on Dam Safety of the Federal Coordinating Council for Science, Engineering and Technology, Washington, DC, 25 June 1979.

(4) Emergency Plan for Winnibigoshish Dam and Reservoir, U.S. Army Corps of Engineers, St. Paul District, October 1985.

(5) Emergency Plan for Lock and Dam No. 10, Near Guttenburg, Iowa, U.S. Army Corps of Engineers, St. Paul District, May 1985.

(6) Mississippi River Headwaters Lakes in Minnesota, Feasibility Study: Main Report, U.S. Army Corps of Engineers, St. Paul District, September 1982.

(7) ER 1130-2-417, Major Rehabilitation Program and Dam Safety Assurance Program, U.S. Army Corps of Engineers, revised edition, 1980.

(8) ER 1130-2-419, Dam Operations Management Policy, U.S. Army Corps of Engineers, 18 May 1979.

(9) ER 1130-2-419, Change 1 Project Operation: Dam Operation Management Policy, U.S. Army Corps of Engineers, 9 April 1982.

(10) Flood Hydrograph Package, HEC-1, U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA, September 1981.

(11) Research Document No. 19, Example Emergency Plan for Blue Marsh Dam and Lake, U.S. Army Corps of Engineers, St. Paul District, August 1983.

(12) Master Reservoir Regulation Manual, Navigation and Flood Control, Mississippi River Headwaters Reservoirs, Minnesota, St. Paul District, Corps of Engineers, April 1963.

(13) Mississippi River Headwaters Reservoirs, Master Plan for Public Use Development and Resource Management, St. Paul District, U.S. Army Corps of Engineers, August 1977.

(14) Earth Manual, Second Edition, U.S. Department of the Interior, Water and Power Resources Service Reprint.

(15) Lambe, T. William and Robert V. Whitman, 1969, Soil Mechanics, John Wiley & Sons, New York.

d. Scope

This plan addresses emergencies related to above normal reservoir water levels and/or rapid release of large volumes of water past the dam. The plan covers identification of impending or existing emergencies, notification of other parties concerning impending or existing emergencies, and emergency operations and repairs. Areas potentially

affected by emergencies are identified for the cases of Probable Maximum Flood without dam failure; Probable Maximum Flood with dam failure; and dam failure at normal high pool level (top of flood control pool).

e. Definitions

(1) Pre-emergency

A "pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam and reservoir is recognized but no significant hazard to life or property is expected to occur. Notification of other Corps offices is required upon declaration of a pre-emergency condition.

(2) Emergency

An "emergency" condition is one in which the occurrence of a significant hazard to life or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent, such as breach of the dam or uncontrollable piping; or longer term, such as predicted large inflows. Warnings to evacuate are required upon declaration of an emergency condition.

2. Description of Project Area

a. Location

Pokegama Dam is located on the Mississippi River, 1183.8 river miles above the mouth of the Ohio River and about 3.5 miles below the outlet of Pokegama Lake. The dam is 344.5 miles by river above St. Paul, Minnesota. The town of Grand Rapids, Minnesota is about 3 miles downstream from the dam (Plate 1).

b. Topography

The reservoir watershed is limited by Winnibigoshish Dam to the northwest, Leech Lake Dam to the west, and Pokegama Dam to the east. Elevations of the Mississippi River valley vary from 1264 feet at Pokegama Dam to 1290 feet at Winnibigoshish Dam. Leech Lake Dam is located on the Leech Lake River at an elevation of 1293 feet. (All elevations in this report are referenced to MSL, 1929 adj.) Relief varies from 80 feet near Winnibigoshish Dam to 410 feet at Sugar Hills, south of Pokegama Lake.

c. Geology

The Pokegama Reservoir area surface geology is made up of several hundred feet of glacial drift. This glacial drift is gray and typically clay rich. The bedrock geology in this area consists of Precambrian Metamorphic and igneous rocks as well as Cretaceous age shales and sandstones to the southeast. The soils in the area are typically loamy sands with some silty lake sediments and reddish clay loam.

d. Climate

The climate of the headwaters area is characterized by long severe winters with snow on the ground from November to March. The mean annual snowfall is 49.5 inches, and the mean annual precipitation is 24.3 inches. Extreme temperatures range from 59 degrees Fahrenheit below zero to 105 degrees Fahrenheit above zero. Normally, the winter months, December through February, are the driest, while the greatest amount of precipitation occurs during June and July.

e. Principal Streams

Pokegama Dam is located on the main stem of the Mississippi River. The total drainage area above Pokegama Dam is 3265 square miles, of which 1442 square miles are above Winnibigoshish Dam, 1163 square miles are above Leech Lake Dam, and 660 square miles are located between Leech and Winnibigoshish Dams, and Pokegama Dam. The major tributary to the Mississippi River above Pokegama Dam is Leech Lake River which has an average discharge of approximately 400 cfs. The confluence of the Mississippi River and Leech Lake River lies 33 river miles above Pokegama Lake. The Mississippi River between Leech Lake River and Pokegama Lake has a slope of about 0.3 feet per mile. Downstream of Pokegama Dam, La Prairie River flows into the Mississippi. La Prairie River has an average discharge of about 280 cfs.

Annual runoff from the area above Pokegama Dam averages 4.70 inches. The average discharge below the dam is 1200 cfs. The mean flow at the dam site is estimated to be 0.37 cfs per square mile.

3. Description of Project Features

The Pokegama Project consists of a lake impounded by Pokegama Dam and four perimeter dikes, outlet works, public use areas and camping facilities. A plan view of the project is shown on Plate 2, and cross sections of the structure are shown on Plate 3.

a. Pokegama Dam

The embankments at Pokegama Dam consist of rock-filled timber cribs backed above and below with earthwork embankments, the surfaces of which

are riprapped and sodded to prevent erosion. The top elevation of both the east and west embankments is 1278.42 feet. The west embankment is 60 feet long, the east embankment is 100 feet long.

b. Control Structure

The control structure consists of reinforced concrete abutments and piers constructed on a quartzite outcrop. There are thirteen sluiceways 8.0 feet wide and one 12-foot wide log sluice. Six of the sluiceways are controlled with sluice gates and eight are controlled with stop logs. A 3-foot walkway over the top of the structure provides access to the sluiceways. The total length of the structure between abutments is 225 feet. The concrete tops of the piers and abutments are at an elevation of 1278.42 feet.

c. Reservoir

Pokegama Reservoir was constructed as part of a project to store water for improvement of navigation on the reach of the Mississippi River from St. Paul, Minnesota to Lake Pepin. Gage zero for Pokegama reservoir is elevation 1264.42. The original minimum stage of 4.5 feet has been raised to 6.0 feet due to pressure from various interests. This change in regulation reduced the storage capacity of the reservoir by about 15 percent.

The maximum operating limit of 12.0 feet has been exceeded 18 times. At a stage of 12.0 feet, beaches, roads and at least one private home would be inundated and heavy erosion could take place with wave action. The maximum stage of record is 13.5 feet. Flowage rights have been acquired to 16.0 feet.

Pokegama Reservoir includes Jay Gould Lake and Blackwater Lake as well as Pokegama Lake.

d. Perimeter Dikes

Four perimeter dikes exist around Pokegama Reservoir. Three of the dikes lie on the tip of the southeastern arm of the lake. The fourth dike is on the northwest side of Pokegama Lake, near the Blandin Paper Mill reservoir and the city of Grand Rapids, Minnesota. The dikes are overgrown with heavy brush and trees, and some are used as road embankments.

e. Public Use Areas

Public use areas associated with the project include a boat ramp, a picnic area, and campground facilities at the Lake Pokegama Recreation Area. This area is located on approximately 8 acres of land downstream of Pokegama Dam on the east bank of the Mississippi River.

f. Instrumentation

The existing hydrologic network in the area of and adjacent to the entire headwaters drainage basin consists of 22 climatological, 31 discharge, and 20 snow survey stations. Within the area of the Mississippi Drainage Basin that is controlled by Pokegama Dam, there are two recording precipitation and temperature stations. One is directly downstream of Leech Lake Dam, on the Leech Lake River, and the other is at Winnibigoshish Dam. Precipitation and temperature stations, one recording and one non-recording, are located at the Pokegama dam site and in Grand Rapids, Minnesota.

Six flowage gages are located within the drainage area: one at Ball Club Lake, two on the Mississippi River and three on the Leech Lake River. There are two reservoir level gages on Pokegama Reservoir and a recording tailwater gage at the dam site. Downstream of the Pokegama dam site there are two recording river gages on the Mississippi River. Two piezometers are embedded in the Pokegama Dam piers.

g. Operations and Maintenance

Pokegama Dam and Reservoir is operated by the U. S. Army Corps of Engineers. A Park Manager resides at the dam to carry out operations and routine repairs. At the present time, the federal government holds fee title to 10.6 acres at the Pokegama dam site. The Corps of Engineers, which administers these lands, also has flowage easements on an additional 66,415 acres. Fisheries Management at Pokegama Lake is the responsibility of the Minnesota Department of Natural Resources.

4. Potentially Affected Project Areas

Emergencies at the Pokegama Dam and Reservoir could endanger the safety of people and property within the borders of the project. The principal areas of concern are the reservoir surface and the Lake Pokegama Recreation Area.

a. Reservoir Surface

The reservoir surface is heavily used for swimming, fishing and boating. Pokegama Reservoir has a surface area of 15,000 acres at average pool elevation.

Dangers to those on the reservoir as the result of an emergency could include strong surface currents in the event of a dam break or flow over the spillway and high waves during storms. However, weather conditions usually accompanying large storms make recreation on the reservoir unlikely during such periods.

b. Pokegama Lake Recreation Area

Pokegama Lake Recreation Area is a park-like lineal development bordered by the Mississippi River to the south. The size of the area is about 10.6 acres and it is only 375 feet wide at its broadest point. This area is vulnerable to inundation by high flows resulting from overtopping or breach of the dam. The terrain of the area in the vicinity of the dam site is relatively flat with an average elevation approximately 10 feet above normal summer pool. The recreation facilities include 15 camping units, 31 picnic units, a boat dock and boat launch, a canoe launch, a playground and day use area and a large parking area.

5. Potentially Affected Non-Project Areas

Emergencies at Pokegama Dam and Reservoir could create a hazard to life and property on non-project lands including those in the vicinity of the reservoir, in Grand Rapids, Minnesota, and along the Mississippi River below Grand Rapids.

a. Vicinity of Reservoir

Much of the land surrounding Pokegama Reservoir is private land and many cabins and residences have been built in the area. The potential for damage in the vicinity of Pokegama Reservoir due to a flood event is high.

Portions of the Burlington Northern Railroad embankment between the towns of Cohasset, Minnesota and Grand Rapids, Minnesota could be gradually inundated due to an emergency affecting Pokegama Dam.

b. Grand Rapids, Minnesota

The town of Grand Rapids, Minnesota, 3 miles downstream, could experience considerable flooding due to an emergency at Pokegama Dam. The Blandin Paper Mill Dam and Reservoir could cause high water levels in Grand Rapids and surrounding communities. An extreme flood event upstream could cause damage to or failure of the Blandin Dam.

The Itasca County highway bridge upstream of Grand Rapids could be cut off due to inundation of approach roads, as could the U.S. Highway 169 bridge downstream of the Blandin Dam.

c. Mississippi River Below Grand Rapids

Downstream of Grand Rapids, homes along the river near the town of La Prairie, Minnesota would be affected due to an emergency event affecting Pokegama Dam. The flood plain downstream of La Prairie is primarily swamp land and forest; an emergency situation affecting Pokegama Dam could cause inundation in this area.

6. Potential Causes of an Emergency

The potential causes of an emergency affecting the operation or safety of Pokegama Dam and Reservoir which were selected for planning include:

a. Excess Seepage

b. Sabotage

c. Extreme Storm

d. Slope Failure

e. Foundation Failure

Each of the above items is discussed briefly in the following paragraphs.

a. Excess Seepage

A potential exists for seepage through, around, or under the dam. Some seepage is normal and is not considered hazardous. However, seepage that increases in amount or contains suspended solids may indicate piping which can lead to breach of the dam. Seepage problems are potentially controllable depending on their severity, location and other circumstances.

b. Sabotage

A potential exists that operation of the dam could be affected by sabotage disrupting communications, disabling gate controls or equipment, breaching the dam or various combinations of the foregoing. Only a breach of the dam, for instance by use of explosives, would cause sudden release of a dangerous volume of water.

c. Extreme Storm

An extreme storm could occur in the area of the reservoir or over the watershed upstream of the reservoir resulting in large inflows to the reservoir. Such a storm would cause a high reservoir level, large discharges over the spillway, and/or high waves on the reservoir surface. The potential for mitigating such problems depends on their severity and other circumstances.

d. Slope Failure

A sliding or sloughing of the dam face could occur. A slope failure that extended to the top of the embankment would effectively lower the crest. This could result in sudden release of a large volume of water if the reservoir water surface exceeded the elevation of the resulting dam crest. The potential for control of slope failure problems depends on their magnitude, severity, reservoir water surface elevation and other circumstances.

e. Foundation Failure

Failure of the foundation underlying either the concrete control structure or the earth embankment dam could occur. This could result in breaching of the dam and control structure, allowing a sudden release of a large volume of water. The potential for control of foundation failure problems depends on their magnitude, severity, reservoir water surface elevations and other circumstances. Continued siltation at the upstream toe of the dam and spillway also contributes to excess foundation pressure, which can cause failure.

7. Computation of Outflow Hydrographs

Outflow Hydrographs were computed for the hypothetical cases of Probable Maximum Flood without failure, Probable Maximum Flood with failure and failure at normal high pool elevation. These three conditions encompass the types of situations potentially resulting from the causes of failures described in Paragraph 6.

a. Computational Procedures

All outflow hydrographs were computed using the dam break component of the U.S. Army Corps of Engineers' HEC-1 model. Table 1 describes the principal parameters of the respective computations for the three cases investigated.

b. Inflow, Outflow, and Reservoir Stage Hydrographs

The inflow, outflow, and reservoir stage hydrographs for Pokegama Dam computed for these three cases are shown on Plates D-5, D-6 and D-7, respectively.

c. Maximum Pool Elevations

The maximum pool elevation computed or occurring in the events of Probable Maximum Flood without and with dam failure is 1282.8. The maximum pool elevation that occurs during failure at normal high pool elevation is 1276.4.

d. Comparison of Computed Peak Outflows

The adopted Probable Maximum Flood has a peak inflow of 47,100 cfs. The computed maximum peak outflow for the case of Probable Maximum Flood with failure is 32,400 cfs. Plate D-8 shows this outflow in comparison to outflows from known dam failures. The hydraulic depth of Pokegama Dam from Probable Maximum Flood level to invert of outlet is approximately 18 feet. The value of the envelope curve shown in Plate D-8 for hydraulic depth of 18 feet is approximately 16,000 cfs which is 16,400 cfs less than the maximum outflow computed for Pokegama Dam. This difference is approximately 50 percent of the computed maximum outflow.

Several failure scenarios for Pokegama Dam were studied. The case of failure concurrent with a Probable Maximum Flood represents a compounding of extremely unlikely events. The case of failure at normal high pool elevation represents much less severe conditions that might occur under normal non-flood conditions. It is doubtful that the historical failure data (Plate D-8) contains events of the magnitude of a Probable Maximum Flood. The envelope curve on that figure lies somewhere between failure at normal high pool elevation and failure at the Probable Maximum Flood peak. For this reason, the computed result for the Probable Maximum Flood with failure lies outside the historical envelope curve.

8. Routing of Outflow Hydrographs

Computed maximum flood elevations and the times for occurrence for the three cases considered at each cross section between the dam and the downstream routing limit are listed in Table 2. Crest profiles of the channel downstream of the dam for the three conditions are shown on Plate D-9. Plates D-10, D-11, and D-12 show the approximate stage hydrographs at selected downstream cross sections for each condition. Hazardous conditions exist when: (1) floodwater depths are in excess of two feet, (2) floodwater velocities exceed four feet per second, (3) floodwater depths are of sufficient elevation to damage property.

9. Inundation Maps

An inundation map package is included in Appendix D to this document. The boundaries of the areas expected to be inundated by the hypothesized conditions of Probable Maximum Flood without failure and Probable Maximum Flood with failure are shown on Plates D-2 through D-4.

10. Affected Areas

The areas affected for the conditions of Probable Maximum Flood without failure and Probable Maximum Flood with failure are indicated on Plates D-1 through D-4. Unless otherwise noted, affected areas outside the inundation boundary are potentially subject to isolation, in most

cases by flooding of roads serving the area. Notes on the plates indicate any areas outside the inundation boundary potentially affected by the secondary problems which might stem from inundation. Table 3 lists the potential secondary problems noted on each plate.

11. Identification of Needed Evacuation Planning

a. Jurisdictions Affected

The area affected in the maximum case of Probable Maximum Flood with failure encompasses parts or all of the following jurisdictions:

(1) Grand Rapids, Minnesota

(2) La Prairie, Minnesota

b. Evacuation Plans

Plans pertinent to the dissemination of flood warnings and evacuation in the portions of the jurisdictions which would be affected in the case of the Probable Maximum Flood with/without failure or a failure at normal pool should incorporate the information presented in this report into all existing and future plans. A copy of this report is to be provided to the appropriate emergency personnel for each of the affected communities.

c. Evaluation of Evacuation Plans

Principal characteristics of evacuation plans which affect their potential for successful evacuation are shown in Table 4.

d. Evacuation Planning

Evacuation plans are to be developed through local coordination with the affected communities. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers. See Appendix D of this report for probable areas of evacuation.

TABLE 1

INFORMATION ON COMPUTATION OF OUTFLOW HYDROGRAPHS

POKEGAMA DAM AND RESERVOIR

Condition	Probable Maximum Flood (PMF) without Failure	Probable Maximum Flood (PMF) with Failure	Failure at Normal High Pool Elevation
Initial Pool Elevation (ft)	1275.0	1275.0	1276.4
Inflow Hydrograph	47,100	47,100	1,000
Breach Type	N/A	Erosion	Piping
Pool Elevation when failure begins (ft)	N/A	1280.4	1276.4
Maximum Pool Elevation Reached (ft)	1282.8	1282.3	1276.4
Maximum Release Rate (cfs)	30,500	32,400	4,900
Ultimate Bottom Width of Breach (ft)	N/A	40.0	50.0
Ultimate Bottom Elevation of Breach (ft)	N/A	1264.4	1268.0
Side Slope of Breach (units horizontal to 1 unit vertical)	N/A	0	.25
Time for Breach to Develop (hrs)	N/A	2.5	3.0

TABLE 2

COMPUTED ELEVATIONS AND TIMES OF ARRIVAL FOR FLOOD WAVE
POKEGEMA DAM AND RESERVOIR

Section	Dist. Below Dam (mi.)	Probable Maximum Flood Without Failure: Max. Elev. (ft.)	Probable Maximum Flood Without Failure: Time of Max. Elev. (hr.)1/	Probable Maximum Flood With Failure: Max. Elev. (ft.)	Probable Maximum Flood With Failure: Time of Max. Elev. (hr.)2/	Failure at Normal High Pool Elevation: Max. Elev. (ft)	Failure at Normal High Pool Elevation: Time of Max. Elev. (hr.)2/
1	0.1	1280.0	96.0	1280.4	48.0	1273.8	3.0
2	1.7	1279.7	102.0	1280.1	51.0	1273.4	36.0
3	3.7	1274.6	102.0	1275.7	51.0	1258.1	36.0
4	4.9	1274.6	102.0	1275.5	54.0	1257.1	39.0
5	5.9	1274.1	102.0	1275.1	54.0	1256.0	39.0
6	6.8	1268.6	105.0	1269.4	54.0	1254.9	42.0
7	7.8	1266.8	105.0	1267.5	54.0	1254.4	45.0
8	8.9	1265.9	105.0	1266.6	57.0	1253.2	48.0
9	10.4	1265.5	108.0	1266.1	57.0	1252.8	51.0
10	12.8	1257.4	111.0	1257.9	60.0	1248.7	69.0
11	15.7	1256.7	114.0	1257.2	66.0	1248.5	93.0
12	18.9	1256.4	120.0	1256.9	69.0	1248.0	111.0
13	22.4	1256.4	126.0	1256.8	75.0	1247.9	132.0
14	26.7	1249.8	135.0	1250.4	84.0	1242.6	156.0
15	31.2	1248.4	141.0	1248.9	90.0	1239.0	171.0

1/ Measured from time reservoir level exceeds top of flood control pool.
2/ Measured from the beginning of failure.

TABLE 3

POTENTIAL SECONDARY PROBLEMS STEMMING FROM INUNDATION

POKEGAMA DAM AND RESERVOIR

Plate	Area1/	Potential Secondary Problem Affecting Area
D-2	1	Inundated roads will affect these non-flooded areas by cutting off transportation into or out of the areas.

1/ Key numbers are shown on Plates D-1 through D-4.

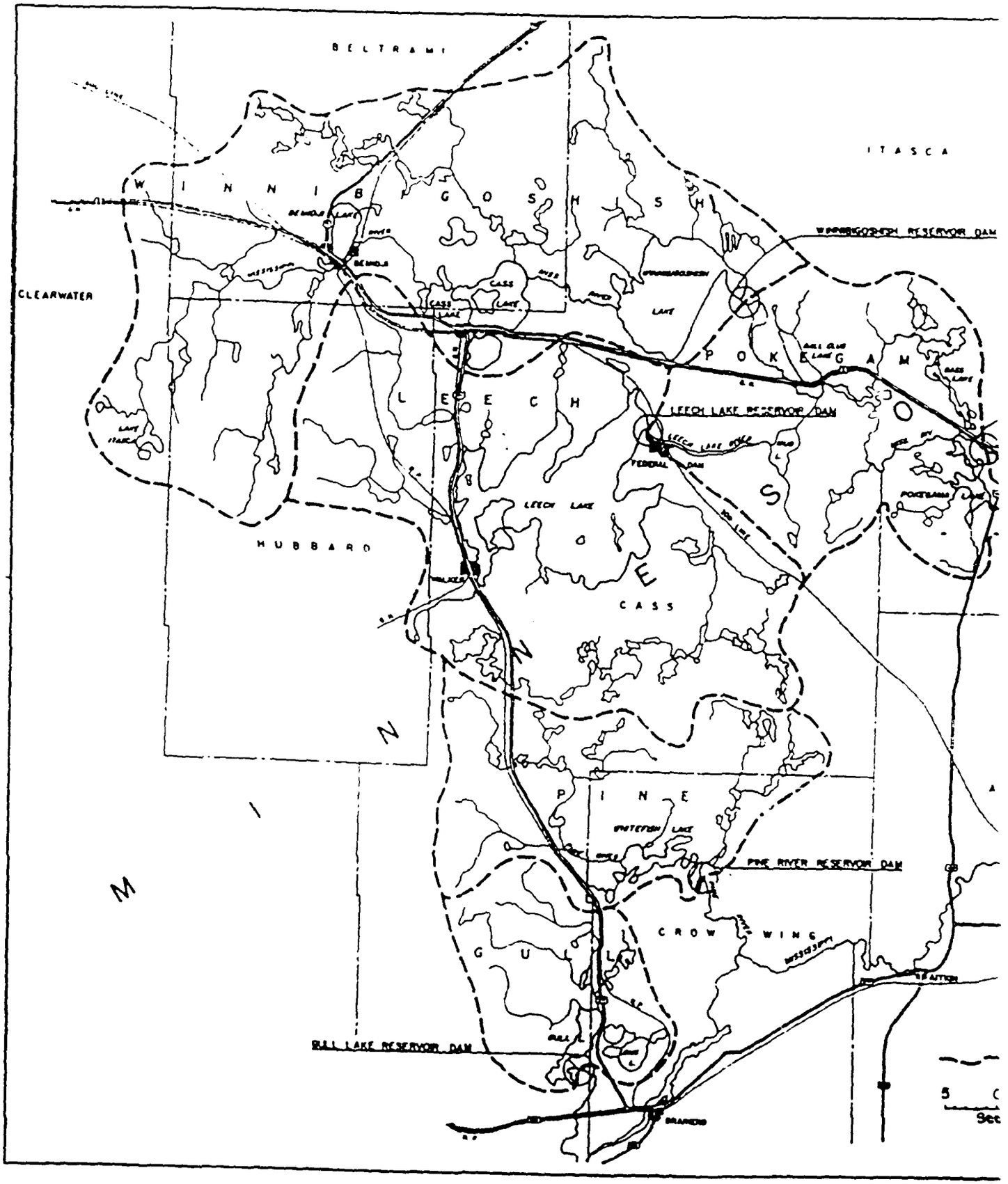
TABLE 4

CHARACTERISTICS OF EXISTING EVACUATION PLANS

POKEGAMA DAM AND RESERVOIR

Plan Characteristic	Plan 1	Plan 2	Plan 3
Is plan written?	No	No	No
Is plan current?			
Does plan have legal status through appropriate adoption or recognition by non-federal authorities?			
Does plan specify actions to be taken in sufficient detail to avoid indecision on whether or not to execute the plan and how it should be executed?	* EVACUATION PLANS ARE A LOCAL RESPONSIBILITY *		
Does plan make specific assignments of responsibility for its initiation and execution?			
Does plan cover all parts of the jurisdiction requiring evacuation?			
Is successful execution of plan in potential emergency situations reasonable in view of the warning time likely to be available for an emergency?			
Is plan consistent with various causes of emergencies likely to exist at time evacuation is required?			
Does plan evidence realistic analysis of means of warning and transporting evacuees, lane capacities of escape routes and other pertinent matters?			
Are equipment, personnel and materials required for execution of the plan identified?			
Does plan contain adequate provisions for updating, testing, practice and other maintenance activities to assure its continued viability?			

CORPS OF ENGINEERS



1112

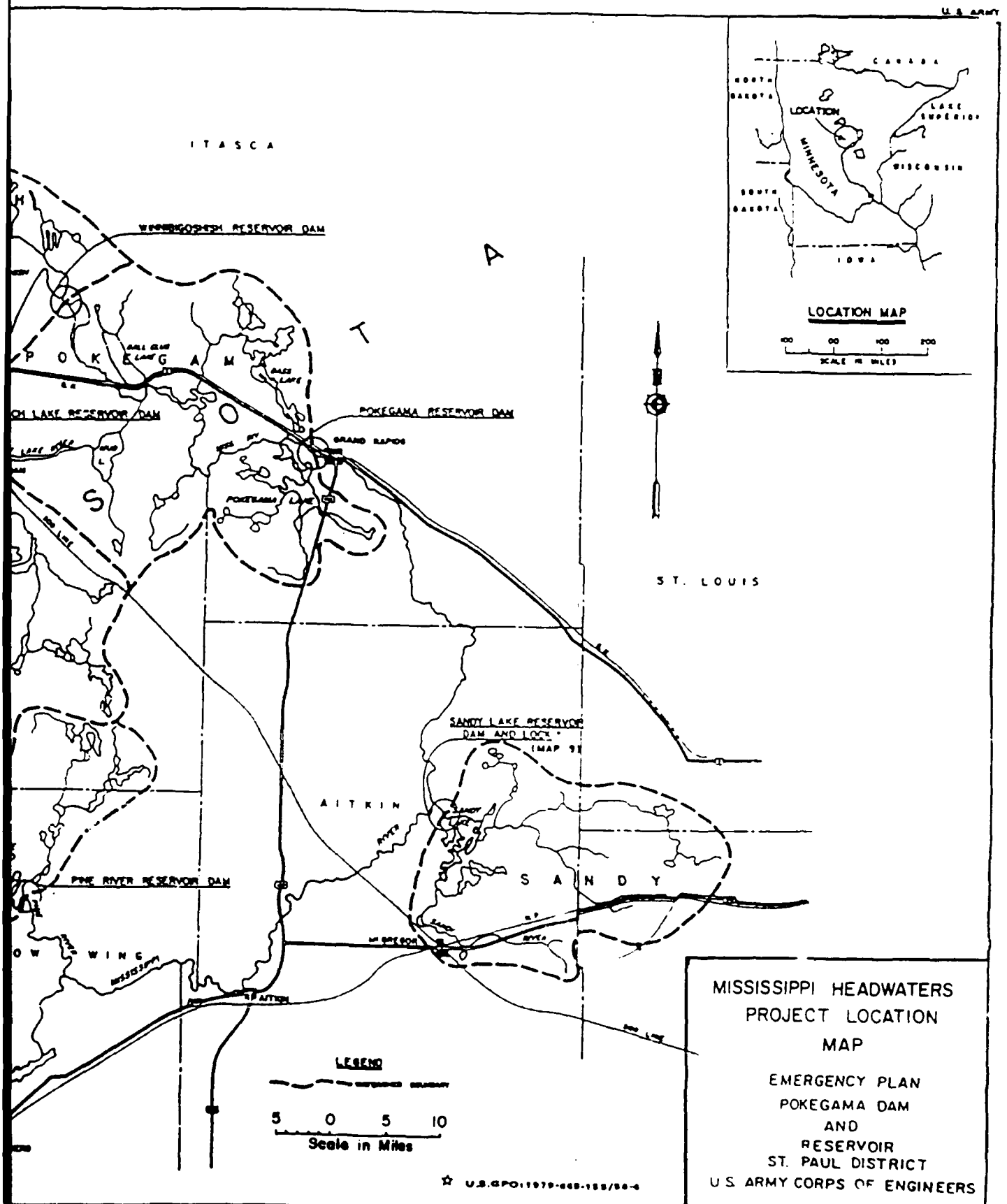
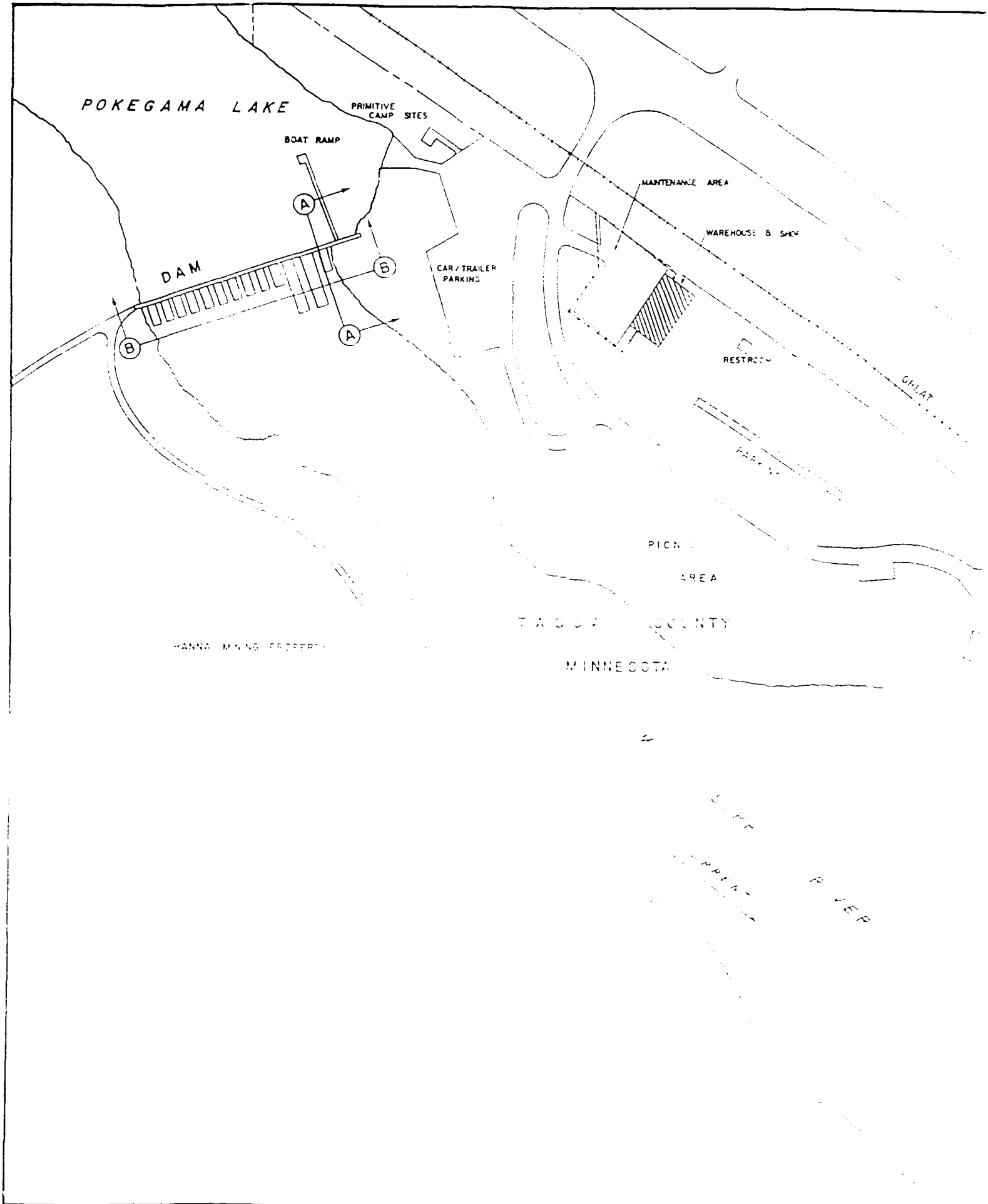
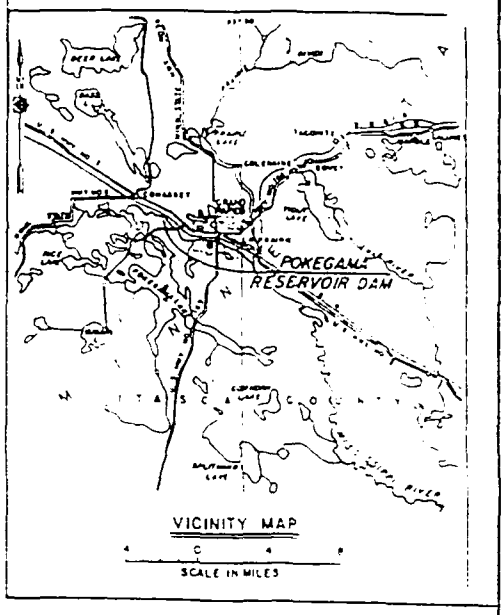

U.S. ARMY
CANADA
NORTH DAKOTA
LOCATION
LAKE SUPERIOR
MINNESOTA
WISCONSIN
SOUTH DAKOTA
IOWA
LOCATION MAP
SCALE IN MILES
ITASCA
POKEGAMA RESERVOIR DAM
GRAND RAPIDS
POKEGAMA LAKE
ST. LOUIS
SANDY LAKE RESERVOIR DAM AND LOCK
AITKIN
PINE RIVER RESERVOIR DAM
S A N D Y
LEGEND
5 0 5 10
Scale in Miles
MISSISSIPPI HEADWATERS
PROJECT LOCATION
MAP
EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE 1


POKEGAMA LAKE
PRIMITIVE CAMP SITES
BOAT RAMP
A
B
DAM
CAR / TRAILER PARKING
MAINTENANCE AREA
WAREHOUSE & SHOP
RESTROOM
GREAT
PARK N
PICN
AREA
TACONITE COUNTY
HANNA MINING PROPERTY
MINNESOTA

U. S. ARMY



U.S.

GREAT

NORTHERN

RAILROAD

RIVER

SANITARY DISPOSAL STATION

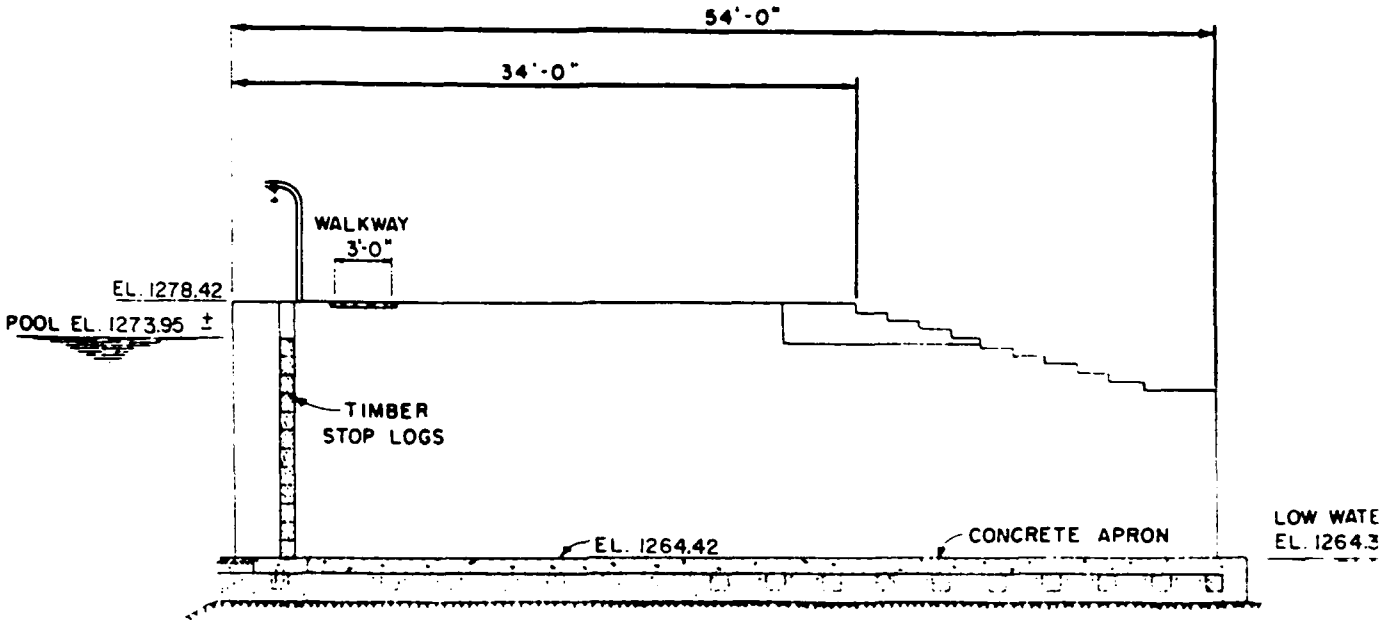
GOVERNMENT PROPERTY LINE

50 0 50 100
SCALE IN FEET

PROJECT FEATURES
PLAN VIEW

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

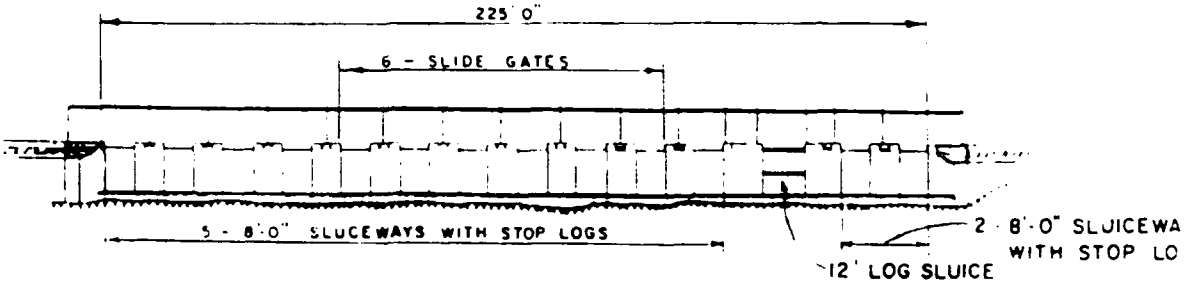
PLATE 2
of 2



SECTION A-A

5 0 5 10 15

SCALE IN FEET

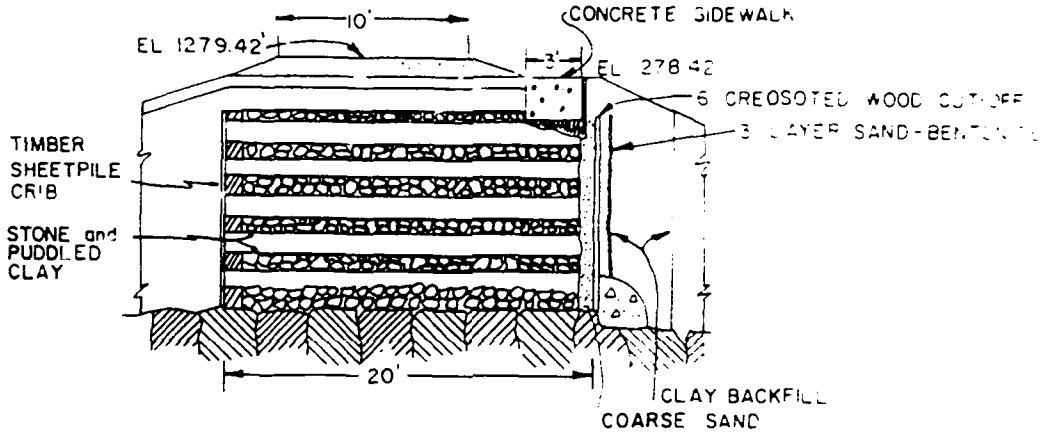


SECTION B-B

40 0 40 80

SCALE IN FEET

LOW WATER
EL. 1264.37



EMBANKMENT SECTION

5 0 5 0 15

SCALE IN FEET

8'-0" SLUICEWAYS
WITH STOP LOGS

CROSS SECTIONS

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE 3

EMERGENCY IDENTIFICATION SUBPLAN

APPENDIX A

TO

EMERGENCY PLAN

FOR

POKEGAMA DAM AND RESERVOIR

MARCH 1987

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EMERGENCY IDENTIFICATION SUBPLAN

POKEGAMA DAM AND RESERVOIR

A-1. Introduction

Conditions affecting operation of Pokegama Dam and Reservoir could result in a hazard to life and/or property due to high reservoir levels and/or sudden release of large volumes of water. Early identification of the existence or potential for occurrence of such conditions is essential as a basis for initiating emergency operations and/or repairs and for issuing appropriate notifications to higher authority and potentially affected parties.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for identifying impending and existing emergencies affecting the operation and safety of Pokegama Dam.

b. Scope

This subplan deals with identification of impending and existing emergencies related to operation error, excess seepage, foundation failure, abutment failure, extreme storm, equipment failure and upstream dam failure. Instructions are included concerning:

(1) Monitoring and reporting conditions.

(a) Routine - during duty hours. Monday through Friday (0800 - 1630).

(b) Non-routine - on a 24-hour basis or as directed by District Office. Additional personnel may be required at discretion of Mississippi Headwaters Project Office.

(2) Communications between the project office, St. Paul District Office, and Mississippi Headwaters Project Office.

(3) Criteria for action including declaration of a pre-emergency or emergency condition and activation of the Notification Subplan and/or Emergency Operations and Repair Subplan.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of Pokegama Dam and Reservoir.

A-2. Definitions

a. Pre-emergency

A "pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected to occur. Declaration of a pre-emergency condition is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

b. Emergency

An "emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent or longer term. Declaration of an emergency condition requires notification of key personnel and issuance of warnings to evacuate potentially hazardous areas.

c. Park Manager

The term "Park Manager" means the dam tender or the individual in charge at the Pokegama Dam and Reservoir project site.

d. Mississippi Headwaters Project Office

The term "Mississippi Headwaters Project Office" means the person in charge of the Mississippi Headwaters Project Office.

e. District

The term "District" means one of the following elements depending upon which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support for keeping the Dam Safety Committee and the NCD Dam Safety Officer informed of the pre-emergency or emergency situation.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the pre-emergency or emergency situation. Also, responsible for matters involving normal dam operations, and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. Provides a 24-hour telephone contact with the District Office. Responsible for keeping the Dam Safety Officer, the Commander/District Engineer, and NCD in contact with the operations and personnel. Also, responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering.

(5) Geotechnical Design Section. A section in the Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the structural integrity of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the outlet structures.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support and matters involving environmental analysis and cultural resources.

A-3. Responsibility For Conduct

a. Park Manager

(1) Carrying out routine surveillance (paragraph A-4a).

(2) Carrying out non-routine observations and measurements as directed by the District (paragraph A-4b).

(3) Advising District of potentially hazardous situations (paragraph A-4c, Table A-1).

(4) Maintaining proper records of communications (paragraph A-5).

(5) Acting independently, when required by disruption of communications or the urgency of the circumstances, to declare a pre-emergency or emergency condition (paragraph A-8) and to activate the Notification Subplan and/or Emergency Operations and Repair Subplan as appropriate.

b. Mississippi Headwaters Project Office

(1) Providing direction and supervision to the Park Manager in coordination with the District Office.

(2) Providing assistance to District as requested.

(3) Assuming responsibilities of District in event of disruption of communications between the project area and District Office.

c. District

(1) Carrying out routine monitoring of conditions potentially affecting regulation of Pokegama Dam (paragraph A-6a) and alerting the Park Manager of situations requiring increased readiness and/or 24-hour supervision.

(2) Providing guidance to the Park Manager on all potentially hazardous situations which arise and directing any non-routine observations and measurements needed to assist in identification, confirmation or analysis of existing or impending threats to safe operation of the dam (paragraph A-6b).

(3) Providing personnel for on-site evaluation of potentially hazardous conditions related to geology, soils and other aspects requiring expert analysis.

(4) Declaring the existence of pre-emergency and emergency conditions and directing activation of the Emergency Operations and Repair Subplan and/or Notification Subplan (Appendices B & C).

(5) Maintenance of the Subplan (paragraph A-9).

A-4. Observations, Tests and Reports by Park Manager

a. Routine Observations and Tests

(1) Monday through Friday (0800-1630).

(a) Maximum, minimum and observed temperature.

(b) Local precipitation at Maintenance Building.

(c) Wind speed.

(d) Pool and tailwater elevations.

(e) Gate Setting.

(2) Weekly.

(a) Snow cover, water content (seasonal) at Maintenance Building.

(b) Test radio and other communications equipment.

(c) Read lake gages throughout the region.

(3) Monthly.

(a) Visual inspection for excess seepage of downstream face of embankment, weir, discharge pipes into outlet works, abutment areas, and valley floor immediately downstream of dam.

(b) Visual inspection for slope failure of both faces of all embankments which are in contact with standing water.

b. Non-routine Observations and Tests

(1) Perform snow surveys as requested (seasonal).

(2) Perform comprehensive examination of seepage (amount, rate of change of flow, and presence of fines) whenever potential problems are observed.

(3) Monitor precipitation gages as directed by the District Office when significant rain is occurring.

(4) Examine all areas of embankment hourly if evidence of significant slope failure is found (to be continued until directed by District to cease).

(5) Perform other observations and tests as directed by the District Office.

c. Reports

(1) To the Chief, Water Control Center (Table A-1).

(a) Reports precipitation of 1.5 inches or more in 24-hours or less in the vicinity of the dam.

(b) Pool elevation above seasonal normal.

(c) Reported severe ice conditions or temporary constrictions downstream of dam.

(d) Any conditions likely to require a change in gate operations or mode of regulation.

(2) To the Chief, Geotechnical Design Section (Table A-1).

(a) Any conditions indicating distress of an embankment.

(b) Indications of unusual seepage.

A-5. Records

The Park Manager will keep a log of all telephone, radio or other communications received from or sent to the District Office. This log should be a bound ledger or notebook used only as an official diary. Each communication will be described including:

a. Date

b. Time

c. Person calling or called

d. Information transmitted/instructions received

e. Action requested by the District

f. Action taken in response to request

g. Result of action

h. Remarks

i. Name of the operator issuing information/orders

j. Initials of person receiving communications

A-6. Observations, Tests and Alerts by the District Office

a. Daily Routine Observations and Tests

(1) Check weather forecasts for areas affecting runoff.

(2) Check concurrence of pool level readings from staff gage and recording gage.

(3) Record, review and analyze piezometer and weir reading data and check with Geotechnical Design Section.

b. Non-Routine Observations and Tests

Specify additional observations and tests by the Park Manager and make additional observations and tests as necessary to:

(1) Assure proper functioning of all instrumentation.

(2) Assist in identification, confirmation or analysis of existing or impending threats to safe operation of the dam.

c. Alerts

Provide alerts to Park Manager and appropriate District Office personnel when:

(1) Weather, ice or other conditions require heightened readiness, increased surveillance or the possible need for activation of the Emergency Operations Center (Appendix C).

(2) Consideration is being given to declaration of a pre-emergency or emergency condition.

A-7. Communications

a. Normal

Communications between the District and Park Manager will normally be by radio. Radios at the Hastings Electronic Service Center and the District Emergency Operations Center will be manned on a 24-hour basis during all flood emergencies and whenever a pre-emergency or emergency condition is in effect. VHF-FM radio is used for communication between Headwaters sites. Radio frequencies and call letters for pertinent parties are listed in Table A-1.

b. Back-Up

The telephone communications network between the District Office and Mississippi Headwaters Project Office will be used to back-up radio communications. Office and home phone numbers of key District Office and Mississippi Headwaters Project Office personnel are listed in Table A-1.

c. Emergency

During a situation when both radio and telephone communications between the District Office and the Pokegama Project Office are lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are listed in Table A-1 along with the information for telephone and radio contacts.

A-8. Declaration of Pre-emergency and Emergency Conditions

a. Responsibility

The District Office is responsible for the declaration of "pre-emergency" or "emergency" conditions in all but extreme cases where the loss of communications or the speed of onset of a situation prevents the Park Manager from conferring with the District Office.

Pre-emergency and emergency declarations will be made by the Commander/District Engineer. The Chief of Engineering Division, members of Geotechnical, Hydraulics and Hydrology Branch, Design Branch, Project Operations Branch and the Emergency Operations Center will provide recommendations for the decision making process.

b. Conditions Warranting Declaration

Not every situation requiring declaration of a pre-emergency or an emergency condition can be specified. Initiative must be exercised by all involved personnel and each situation judged individually on the basis of all relevant factors.

(1) Pre-emergency

Examples of circumstances warranting declaration of a pre-emergency condition include:

(a) Spring runoff is always handled as a pre-emergency condition. During the remainder of the year, a condition warranting declaration of a pre-emergency occurs when Willow Beach, Minnesota is near stage 1284.0, and inflow to the lake is increasing.

(b) Malfunction of the flood control gate system during flood operations which impedes release of water and creates potential for overtopping.

(c) Minor seepage problems including: unexplained increases or decreases in amount, cloudy appearance of seepage or presence of fines, developing of new seepage areas as indicated by soft boggy areas or new or lush vegetation, and substantial unexplained fluctuation in piezometer readings.

(d) Minor slope failures including: tension cracks in the crest or slopes of embankment, small bulges in slopes or in foundation near toe of slope, small depressions or sags in crest or slopes, changes in horizontal crest alignment, and gullies forming in or near embankment or junction of the embankment abutments.

(e) Threats of sabotage or occurrence of sabotage of non-critical project features.

(2) Emergency

Examples of conditions warranting declaration of an emergency condition include:

(a) Pools are over summer band, and inflows are increasing.

(b) Major seepage problems including: large increases in piezometer readings, movement of large amounts of material in existing or new seeps, pipes in embankment or foundation materials, seepage at higher elevations on downstream face of dam or in abutment areas, and substantial increases in normal seepage amounts (especially when associated with movement of material from embankment of foundation.)

(c) Major slope failures including: appreciable depressions or sloughs in the crest or slopes of the dam or bulges in the slopes or foundation, large gullies developing and continuing to erode in the embankment or at the junction of the embankment and abutments, displacement of structures or instrumentation on the dam and continuing expansion of tension cracks after their appearance on the dam crest or slopes.

(d) Threats of sabotage or occurrence of sabotage to critical project features.

c. Action Upon Declaration

(1) Park Manager

(a) Attend telephones as directed by the District Office. Cancel normal schedules and provide for 24-hour duty as needed.

(b) Activate appropriate portions of Emergency Operations and Repair Subplan and/or Notification Subplan (Appendices B & C).

(c) Maintain 24-hour monitoring/surveillance of situation responsible for declaration.

(d) Perform non-routine observations and tasks as directed by the District Office.

(e) Test radio communication.

(f) Request assistance needed from the District Office to perform (a) through (e) above.

(2) Mississippi Headwaters Project Office

(a) Monitor telephones on a 24-hour basis.

(b) Place all personnel on standby for emergency duty if directed by District Office.

(c) Test radio communications.

(3) District Office

(a) Activate Emergency Operations Center.

(b) Attend telephones on 24-hour basis.

(c) Test radio communications.

(d) Place key staff on standby for emergency duty (Table A-1).

(e) Provide detailed instructions to the Park Manager for directing specific non-routine observations and tests.

(f) Dispatch personnel to dam site as required to provide expert evaluation of situation and to assist Park Manager as needed.

(g) Activate appropriate portions of Emergency Operations and Repair Subplan and Notification Subplan (Appendices B & C).

A-9. Subplan Maintenance

a. Updating

This subplan shall be updated as needed by the Dam Safety Officer, including;

(1) Annually.

(2) Whenever needed by modifications in instrumentation at or affecting the project, dam operating procedures, overall District emergency procedures, and/or changes of personnel.

b. Testing

The Chief, Project Operations Branch shall annually direct a thorough inspection of all mechanical, electrical, and other equipment pertinent to conduct of this subplan. The inspection shall include all tests, servicing and calibration necessary to ensure proper functioning.

c. Familiarization

The Dam Safety Officer shall ensure all pertinent Corps personnel are aware of and familiar with this subplan including:

(1) Circulation of each updated version for review and signature by pertinent District staff, the Mississippi Headwaters Project Office and the Pokegama Dam and Reservoir Project Office.

(2) Periodic review session with staff of the Water Control Center and Park Managers.

(3) Briefing, within two weeks of assuming duties, of all new Water Control staff.

(4) Briefing, before assumption of duties, of any new Park Manager.

TABLE A-1
Information on Key Contacts

PARTY	TELEPHONE NUMBER OFFICE	TELEPHONE NUMBER RESIDENCE	RADIO FREQUENCY	RADIO CALL LETTERS
DISTRICT PERSONNEL				
Resource Manager				
Clarence Bernardson	(218)326-6128	(218)326-8166	SSB	WUD633
Mississippi Headwaters Project Office				
James Ruyak	(218)566-2306	(218)566-1294	SSB	WUD639
St. Paul District Office				
Emergency Operations Center[1] Twenty-four (24) hour telephone service. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving national security, disasters, mobilization or NWS flood forecasts. Center will contact Dam Safety Officer, the Commander/District Engineer and NCD.				
District Emergency Operations Center	(612)220-0208		Contact Hastings Electronic Service Center at (612)437-2210(call letters - WUD6)	
David Christenson, Chief, Emergency Management	(612)220-0204 (612)690-5749			
Natural Disaster Planner	(612)220-0204			
Project Operations Branch Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving normal dam operations, and/or matters not covered by other District elements. Project Operations Branch will contact Dam Safety Officer for engineering and technical assistance and keep him informed of situation.			SSB(Primary 5040Khz) 1st Alternate- 6020Khz LSB) (Emergency- 5015Khz LSB)	
Dennis Erickson Chief, Natural Resource Management Section		(612)220-0325	(612)452-6850	
Thomas Oksness, Chief, Lock and Dam Section		(612)220-0322	(612)439-0272	
Dennis Cin, Chief, Project Operations Branch		(612)220-0320	(612)455-6786	
Dam Safety Officer To be informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency or emergency situation.				
Robert Post, Chief, Engineering Division		(612)220-0303	(612)437-1316	

TABLE A-1
Information on Key Contacts (continued)

PARTY	TELEPHONE NUMBER OFFICE	TELEPHONE NUMBER RESIDENCE	RADIO CALL LETTERS
Water Contol Center[3]			
For matters involving reservoir regulation.			
Edward Eaton, Water Control Center[1]	(612)220-0617	(612)731-9426	WUD613
Bonnie Montgomery, Water Control Center[1]	(612)220-0618	(612)450-0909	WUD613
Gordon Heitzman, Water Control Center[1]	(612)220-0620	(612)429-9500	
Kelsey Willis, Water Control Center[1]	(612)220-0619	(612)566-5022	
Helmer Johnson, Chief, Geotechnical, Hydraulics & Hydrologic Engineering Branch[1]	(612)220-0602	(612)633-7791	
Geotechnical Design Section[3]			
For matter involving the structural integrity of the dam			
W. Grant Westall, Geotechnical Design Section	(612)220-0644	(612)455-7632	
Helmer Johnson, Chief, Geotechnical Hydraulics & Hydrologic Engineering Branch	(612)220-0602	(612)633-7791	
Design Branch[3]			
For matters involving the structural integrity of the outlet structures.			
Marlin Munter, Chief, Design Engr. Section[1]	(612)220-0511	(612)784-6123	
Charles Spitzack, Chief, General Engr. Section[1]	(612)220-0512	(612)645-7301	
Robert Fletcher, Chief, Design Branch[1]	(612)220-0510	(612)484-4998	
Others[3]			
If none of the above can be reached.			
Dale Mazar, Chief, Project Management Br.[2]	(612)220-0444	(612)631-1940	
Wayne Knott, Chief, Environmental Resources Br.[2]	(612)220-0400	(612)739-2724	
Louis Kowalski, Chief, Planning Division[2]	(612)220-0307	(612)457-6453	
Ltc. David Nelson, Deputy Commander[2]	(612)220-0301	(715)247-5661	
Col. Joseph Briggs, District Commander[2]	(612)220-0300	(612)894-7142	
Aitkin County			
Civil Defense Director		(218)927-2102	(218)335-3902
Sheriff (24 hours)		(218)927-2138	
Itasca County			
Civil Defense Coordinator		(218)327-2878	(218)832-3902
Sheriff (24 hours)		(218)326-3477	
Emergency		911	
State of Minnesota			
Statewide Emergency Number	1-800-422-0798		
Metro Area	(612)649-5451		
Backup Only	(612)296-2100		

MN State Patrol[4]	(612)482-4901

1 Call personnel in order listed until contact is made.
2 To be called in the order listed.
3 To be contacted if no contact can be made with other elements.
4 Potential Sources of Assistance in Communication.

EMERGENCY OPERATIONS AND REPAIR SUBPLAN

APPENDIX B

TO

EMERGENCY PLAN

FOR

POKEGAMA DAM AND RESERVOIR

MARCH 1987

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EMERGENCY OPERATIONS AND REPAIR SUBPLAN

POKEGAMA DAM AND RESERVOIR

B-1. Introduction

Conditions affecting operation of Pokegama Dam and Reservoir could result in a hazard to life and/or property due to high reservoir levels or sudden release of large volumes of water. Prompt conduct of emergency operations and repairs is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for emergency operations and repairs to deal with impending and existing emergencies affecting the operation and safety of Pokegama Dam and Reservoir.

b. Scope

This subplan describes emergency operations and repairs to be implemented upon declaration of a pre-emergency or emergency condition. Operations and repairs are described for cases of:

(1) Excess seepage and/or malfunctioning of the dam's internal drainage system.

(2) Wave erosion and/or erosion of the downstream face of embankment.

(3) High reservoir level.

(4) Slope failure.

(5) Threatened sabotage.

(6) Sabotage.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of Pokegama Dam and Reservoir.

B-2. Definitions

a. Pre-Emergency

A "pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected to occur.

b. Emergency

An "emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent or longer term.

c. Park Manager

The term "Park Manager" means the dam tender or the individual in charge at the Pokegama project site.

d. Mississippi Headwaters Project Office

The term "Mississippi Headwaters Project Office" means the person in charge of the Mississippi Headwaters Project Office.

e. District

The term "District" means one of the following elements depending upon which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the Pre-Emergency or emergency situation. Also responsible for keeping the Dam Safety Committee and the NCD Dam Safety Officer informed of the pre-emergency or emergency situation.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the pre-emergency or emergency situation. Also, responsible for matters involving normal dam operations, and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. Provides a 24-hour telephone contact with the District Office. Responsible for keeping Dam Safety Officer, the Commander/District Engineer, and NCD in contact with the operations and personnel. Also responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving reservoir regulation.

(5) Geotechnical Design Section. A section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the structural integrity of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the outlet structures.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support, and matters involving environmental analysis and cultural resources.

B-3. Basis of Activation

This subplan is to be activated immediately upon declaration of a pre-emergency or emergency condition. See Appendix A, Emergency Identification Subplan, for procedure of declaring a pre-emergency or emergency condition.

B-4. Responsibilities

a. Park Manager

(1) Provide information to District on existing severity and rate of change of problem.

(2) Request needed assistance from the District including:

(a) Personnel, including expert supervision.

(b) Equipment.

(c) Materials.

(3) Carry out operations and repairs as directed by District.

(4) Act independently to implement emergency operations and repairs in the event communications with the District are disrupted or immediate action is required including:

(a) Deciding the urgency of correction.

(b) Carrying out appropriate portions of the Emergency Operations and Repairs Subplan.

(c) Obtaining needed personnel, equipment and materials (paragraphs B-5 and B-6).

b. Mississippi Headwaters Project Office

(1) Provide personnel, equipment and materials to Park Manager or as directed by the district.

(2) Direct emergency operations and repairs in the event communications between the Park Manager and District are disrupted.

c. District

(1) Assess problem and Park Manager's request for assistance with respect to:

(a) Urgency for correction.

(b) Type of corrective actions required.

(c) Personnel required for corrective actions including requirements for expert advice and/or on-site supervision.

(d) Equipment and materials required for corrective actions.

(2) Provide direction to the Park Manager on emergency operations and repairs to be carried out.

(3) Dispatch needed personnel, equipment and materials to the project from the District (paragraph B-5 and B-6).

(4) Arrange needed personnel, equipment and materials from sources other than District.

B-5. Emergency Operations and Repairs - Excess Seepage and/or Malfunctions of the Dam's Internal Drainage System

a. Potential Problems

Abnormal seepage may occur as rapid and/or significant increases in the amount of flow through the sand collection blanket or the seepage drains emptying into the outlet works; boils in the embankment or foundation; and creation of new seep areas on the downstream face of the embankment, foundation, abutments or areas immediately downstream of the embankment. Seepage high on the face of the embankment, large amounts of seepage, and seepage carrying fines are especially serious. Boils and seep areas may also be caused by a malfunction of the dam's internal drainage system. Excess seepage problems are most likely to occur when the reservoir water level is at higher than normal elevation.

b. Corrective Action

Individual boils or small areas of seepage can be controlled on a temporary basis by ringing them with sand bags or other materials. Longer term control and control of large areas of seepage can be affected by covering the area with a 3 to 5 foot deep layer of granular material graded from coarse sands at the bottom to coarse gravels at the top. Lowering of the reservoir pool level reduces pressure on seepage areas and aids in control.

(1) Solutions to Combat Sand Boils.

A sand boil may gradually undermine a dam and result in a failure by causing settlement and sloughing of the dam. As long as the flow is steady and not increasing, and no material is being carried, the danger is relatively small. In times of forecasted high water all locations of prior boils and any newly developed boils should be watched closely, especially those within 100 feet of the toe of the embankment. All boils should be conspicuously marked with flagging so that patrols can locate them without difficulty and observe changes in their conditions. A sand boil which discharges clear water in a steady flow is usually not dangerous to the safety of the dam. The only action necessary in this case is to drain the excess water off to prevent it from standing near the dam. However, if the flow of water increases and the sand boil begins to discharge material, corrective action should be undertaken immediately.

A common method of handling sand boils involves walling up a water tight sack ring around the boil until the water in the ring has attained sufficient head to counteract the head causing the boil. This is shown graphically on Plate B-1. Ringing boils with steel piling is shown on Plate B-2. It is not necessary or desirable to check the flow of water

completely, as this may cause other boils to break out in the vicinity. It is necessary, however, to reduce the velocity of flow, and to stabilize the movement of sand, silt and other materials through which the water stream passes. A boil at the toe of the embankment is not necessarily more dangerous than one at a considerable distance landward from the toe.

(2) Solutions to Combat Seepage

Remedial measures to combat excessive embankment seepage may be performed on either the upstream or downstream slopes.

(a) Downstream remedial work should allow the seepage water to flow as freely as possible while preventing migration or loss of existing soil materials from the embankment or foundation. If seepage causes sloughing of the landward slope, it should be flattened to a 1V to 5H slope or flatter. Since seepage on a slope indicates effective pervious embankment behavior or worse, material for flattening must be more pervious than the embankment material.

(b) The upstream treatment, when the seepage is heavy or the embankment shows signs of sloughing, would consist of banking or sandbagging the area under the pool with additional earth or other materials. This would minimize the entry of water into the foundation and/or the embankment.

(c) When water does seep through a foundation or embankment, material may be carried along with it, causing sink holes to appear in the embankment. These holes should be filled with sandbags or earthen material as soon as possible.

c. Resources Required

(1) Resources Required for Combatting Seepage (Placing Granular Blanket).

(a) Materials

The characteristic of sand and gravel mixtures to allow the passage of water while at the same time preventing the passage of soil grains is extensively used in the design of water retaining structures. The properties of resistance to displacement by flowing water, resistance to wear from vehicular traffic, and the maintenance of strength and limited volume change over a large range of water contents make sand and gravel useful in providing surface protection to dams and canal banks. The wide range in gradation possible in sand and gravel mixtures,

together with the wide range in structural materials to be protected, results in a wide range of acceptability for the materials used for sand and gravel or crushed rock blankets. The engineering properties and uses for various soil types are listed on Plates B-8 and B-9.

Natural sand and gravel deposits normally contain excessive amounts of sand. However, if these materials are clean (contain less than 5 percent fines), almost any sand and gravel mixture can be used for downstream drainage blankets for earth dams by thickening the pervious blanket sufficiently so that seepage through the embankment and foundation can be carried within the blanket section. For some cases involving seepage through the foundation, it can be shown that the effective weight of the blanket must be equivalent to or greater than the total head in order to prevent rupturing boils or piping. Sometimes only 50 to 75 percent of the total head is required for effective weight of the blanket. For the pervious blankets between riprap and rolled earthfill, the requirements for the sand and gravel material become less critical as the thickness of the riprap layer increases. Generally, material from a natural deposit can be utilized if at least 50 percent of the material is in the gravel size range when riprap blankets of 3-foot normal thickness are specified. In those ranges of reservoir operation where anticipated wave action is comparatively rare, some relaxation of material requirements is also possible.

(b) Equipment

Placement of granular blankets requires equipment including:

(i) Dump trucks for transportation of materials to point of placement. The number of trucks required depends on the haul time and desired time of completion.

(ii) Tractors with blades for grading. One tractor is usually capable of grading up to about 500 square feet per hour.

(iii) Shovels and rakes for hand placement of materials.

(c) Personnel

In addition to drivers for trucks and other mechanized equipment, labor is required for various other tasks. The number of personnel required for this purpose depends on the size of the area being treated and desired speed of completion. Labor requirements for

various tasks can be approximated from Tables B-1, B-2, and B-3 and Plate B-3.

(2) Resources Required For Ringing Boils

(a) Materials

Materials required for ringing boils include:

(i) Sandbags.

(ii) Sand.

(b) Equipment

Shovels are the only equipment required for ringing small boils. For larger areas of seepage, consideration should be given to use of a granular blanket. In the event larger areas must be treated by sandbagging, consideration should be given to use of transit concrete trucks, front end loaders or other mechanized equipment to fill and move bags. Typical sections for ringing boils are shown on Plates B-1 and B-2.

(c) Personnel

Curves to estimate the time (in hours) needed to place sandbags to construct various sizes of sandbag rings under various conditions are shown on Plate B-3.

(3) Lowering of Reservoir Pool Level

(See Section B-8.b.)

d. Technical Directions

(1) Placing Granular Blanket

A requirement of all blankets is careful placement. Requirements may vary widely according to the type and location of the blanket placement, but in every case uniformity and thickness are very important. (For additional information see Earth Manual, Reference 14). Blankets may be placed by the following methods:

(a) By the use of mobile dragline machines. Material may be obtained from the borrow pit or from trucks and dumped on the crown of the dam. The blanket should extend well above, below and to both sides of the affected area, and the material should be distributed as evenly as practical on both the downstream slope and berm. Dozers could be used to push the material from

the abutments where turn around room may be available.

(b) By shoveling material by hand from trucks unloaded on the crown of the dam.

(c) Great care should be taken so that equipment loading does not cause failure of the dam.

(2) Ringing Boils

(a) Multiple nearby boils or soft areas in vicinity of boil should be included within sandbag ring.

(b) Build ring only high enough to slow water flow to point that no fines are carried. However, do not completely shut off the flow of seepage.

(c) Base of sandbag ring should be at least one and a half times the contemplated height. Typical sections for ringing boils are shown in Plates B-1 and B-2.

(3) Sandbags

Procedures for filling, handling, and placing sandbags are presented in Section B-6 of this report.

B-6. Emergency Operations and Repairs - Wave Damage and/or Erosion of the Downstream Face of the Embankment.

a. Potential Problems

Wave damage may occur during a period of high winds at the Dam and Reservoir. Damage may include displacement of riprap and/or erosion of the underlying materials causing collapse of the riprap. Wave damage is particularly serious during abnormally high reservoir pool levels when damaging erosion can cause a sudden collapse of the crest with subsequent overtopping of the embankment.

Description. Wave wash is the erosion of the upstream slope of the dam by wave action. This action may be caused by storms and shore winds and may be particularly dangerous on open reaches where the slope is not protected by riprap or timber and brush screens. Sand slopes and unsodded slopes are much more susceptible to wave wash than well-sodded slopes. Wave action may seriously damage a dam, particularly if the water surface is near the dam crown, if the reservoir pool is constant for a relatively long period of time, or if a slope is newly constructed or of sandy soil. Although the necessity for wave action protection cannot always be foreseen, the probable spots where wave wash might occur as known from past observations, will give a good idea of where material and supplies should be concentrated. Upon discovery of a damaged wave wash section or the beginning of wave wash damage, action should be taken to prevent further damage.

b. Corrective Action

The type of corrective action which is appropriate depends on the severity of damage, rate of progression of damage, and urgency of action. Temporary protection above and within 10-12 feet of the waterline can be provided quickly by use of plywood or canvas or polyethylene sheets or by filling eroded areas with sandbags. Placement of polyethylene sheets is illustrated in Plate B-4. Protection further below the water level can be provided by dumping riprap in the affected area. A strip of cotton or burlap bag over the affected area weighted down by sandbags is very effective in combating erosion. Sack revetment and construction of sandbag barriers are illustrated in Plates B-5 and B-6, respectively. In cases of severe erosion, lowering of the reservoir pool level can shift wave forces to a lower elevation. Repairs normally require reconstruction of the eroded slope and replacement of both bedding materials and riprap. Lowering of the pool level is usually required prior to making permanent repairs.

c. Resources Required

(1) Temporary protection with plywood

(a) Materials

(i) One-half inch exterior plywood

(ii) Concrete blocks or sandbags for use as weights

(iii) Stakes (2" x 4" x 3'-0")

(iv) 12 gauge galvanized tie wire

(v) Tie cord

(b) Equipment

(i) Sledge hammers

(ii) Wire cutters

(iii) Pike poles

(iv) Shovels

(v) Drill, 1/4"

(c) Personnel

The number of personnel required to put various areas of protection in place using plywood can be approximated from Plate B-7.

(2) Temporary Protection with Canvas

(a) Materials

(i) Wavewash canvas, 7' wide

(ii) Stakes (2" x 4" x 3'-0")

(iii) One and one-half inch pipe for bottom stiffener (20' lengths).

(iv) Concrete blocks or sandbags for use as weights.

(v) 12 gauge galvanized tie wire

(b) Equipment

(i) Sledge hammers

(ii) Wire cutters

(iii) Pike poles

(iv) Shovels

(c) Personnel

The number of personnel required to put various areas of temporary wave protection in place using canvas can be approximated by making assumptions using Plate B-7.

(3) Temporary Protection with Sandbags

(a) Materials

(i) Sand

(ii) Sandbags

(b) Equipment

(i) Sack racks and stabilizing pins

(ii) Shovels

(iii) Cement transit trucks

(iv) Other trucks

(v) Wheelbarrows

(c) Personnel

The number of personnel required to fill and place sandbags can be approximated by assuming that under average conditions with a crew of 2 to 10 men and 1 crew leader it would take four hours to place one cubic yard by hand at the place of filling. Also, see Table B-3 and Plate B-3.

d. Technical Directions

The construction of emergency protection projects is dependent on local working conditions, resources available, and the methods employed. The most efficient system of either mechanical or manual means of construction should be selected to meet the criteria of the emergency.

(1) Manual Labor

Manual labor can be a very effective way of accomplishing the necessary emergency tasks. Availability of a large work force or conditions that restrict the use of vehicles and/or mechanical devices are examples of situations that lend themselves to the use of manual labor. The availability, need and use of manual labor should be given careful consideration ahead of time. Resources should be identified so that they can be quickly mobilized for an emergency.

(a) Sacking Operation

Sacks filled with earth material are suitable for almost every phase of emergency high water protection work. In many situations sacks provide the most practical and effective emergency deterrent. However, the labor force required (Plate B-3), duration of placement and cost, including purchase, filling, handling and removal should be considered, with discretion exercised so that the application of sacks is advantageous when compared to other methods.

(i) Filling Sacks

(aa) For seepage and sandboil control, a completely filled sack is detrimental. Instead a half filled sack should be used.

(bb) For wave erosion protection the sacks should be well filled and the material shaken down into the sack, but not tamped. A well-filled sack will measure approximately 12" x 24" x 8" and will contain 1 1/3 cubic feet of material, weighing about 130 pounds. Sacks for wave erosion protection should be sewn shut at the top.

(cc) The top of each sack can be loose, tied or sewn depending on the proposed use. If large curved steel needles are not readily available for sewing the sacks, suitable needles can be made out of almost any kind of wood. The wooden needle should be about 7 inches long, whittled down to a diameter which will permit passage through the sack material - about 1/4 inch to 5/8 inch - with a large eye cut in one end and a point on the other. Any heavy twine is suitable for sewing the sacks.

(dd) When it is necessary to fill a large number of sacks in a short period of time, a sack rack should be used. One type of sack rack can be made by driving three stakes in the ground with their tops above the ground to the approximate height of the sack.

(ii) Transporting Sacks

Sacked material may be transported around the site in wheelbarrows, in handbarrows, or on people's shoulders.

(aa) Wheelbarrows are preferable as two filled sacks constitute a load for one wheelbarrow which can be handled by one person if smooth-run planks and a suitable grade are provided.

(bb) When necessary, filled sacks are transported on a person's shoulder, one sack per person.

(cc) Handbarrows, carried by two people, can be used to transport two sack loads over longer distances. A handbarrow may be made of two hand bars and two sacks. The hand bars are two poles about 5 feet long, from 1 1/2" to 2" in diameter. Any local wood that has sufficient strength is suitable. The handbarrow is assembled by slipping the hand bars through the bottom corners of an empty sack, taking care not to slit the openings in the sack larger than necessary. The second sack is slipped on in a similar manner, but in the reverse direction so that one sack is telescoped into the other. The sacks should be securely fastened to the hand bars by small nails.

(dd) Under certain situations, consideration should be given to filling sacks off site

and transporting them to the problem area by truck or perhaps on pads flown to the spot by cargo type helicopters. In instances where vehicles must be sent over roads that are impassable due to mud or sand, their safe passage may be provided by the use of a plank road. When travel or other satisfactory means of communication cannot be maintained, telephone communication should be provided along dangerous stretches of the dam.

(2) Mechanical Methods

If an emergency project is large and/or must be completed quickly, consideration should be given to the use of mechanical methods. They offer a versatile and effective way to construct emergency works in situations that require the rapid deployment of equipment and labor force in order to meet the urgent time requirements that emergencies demand.

(a) Mechanical Methods for Sacking

Sacking operations can be accelerated with the use of mechanical equipment. A small trenching machine can dig material and discharge it to the side. Another scheme would be to use a small dragline and combination hopper-belt conveyor so that sacks could be filled directly on trucks with a minimum of laborers required.

(b) Mechanical Tools to Speed Up Production

If conditions warrant, electric saws, air hammers, etc., could be used to speed up the mass production of such articles as cribs, board sections of movable wavewash protection and other earth retaining structures.

(c) Use and Planning of Mechanical Methods

The use of mechanical equipment calls for innovative and immediate decisions to ensure that the required emergency protective works are constructed as quickly as possible.

Repair procedures and where to obtain heavy equipment, tools, materials and other resources, should be given serious thought and action during nonflood seasons so that they can be carried out in the most efficient manner possible.

B-7. Emergency Operations and Repairs - Abutment, Foundation, or Embankment Failure

During periods of above normal pool, the abutments, foundation, and embankment should undergo close inspection. Also, after periods of high pool a close inspection should be made to assess significant changes in these features. Notification of any potential pre-emergency conditions or emergency conditions should be immediately made following the guidance in Appendix C.

B-8. Emergency Operations and Repairs - High Reservoir Level

a. Potential Problems

High reservoir levels cause large hydrostatic forces on the dam, reduce freeboard available to contain wave action and reduce the capability of the dam to impound major inflows without overtopping or uncontrolled spillway flow. High reservoir levels contribute to excess seepage, piping, wave erosion and other safety problems. High water levels can also result in property damage and creation of safety problems around the periphery of the lake.

b. Corrective Action

The only corrective action for high water levels is increasing releases. When the spring ice breakup begins, the outflow is reduced to 200 cfs and the balance of the inflow is stored until the pool reaches an elevation of 1273.67, the desirable summer level. If the pool continues to rise above 1273.67, flood damage within the reservoir and downstream conditions govern the amount of discharge. The situation at stations on the Mississippi River from Fort Ripley to the Twin Cities is considered in determining the outflow. If protection from flooding is needed at any of these stations, the inflows are stored as necessary until the maximum regulating limit, elevation 1276.42, is reached. At this elevation, set the discharge equal to inflow. At this point, if inflow exceeds the dam capacity, the dam is completely opened and open river conditions exist until pool levels fall and regulation becomes possible again. Discharge is governed by damage within the reservoir and downstream conditions until the spring breakup is completed.

B-9. Emergency Operations and Repairs - Slope Failure

a. Potential Problems

Slope failure may occur as the mass movement of a portion of the embankment. Such failures weaken the dam, and if located sufficiently high on the embankment may cause a breach, or lead to collapse of the dam crest. Slope failures of any significant magnitude are serious and require immediate corrective action and notification of proper personnel according to Appendix C.

b. Corrective Action

(1) Lowering of the upstream pool should be done in the event of any slope failure that is sufficiently serious to threaten the safety of the dam or dike areas. (See Reservoir Regulation Manual, Reference 12).

(2) Immediate treatment of slope failures consists of filling slide areas with riprap, sandbags or a granular blanket. The preferred method depends on materials and labor available and the urgency of action. When the urgency of the situation permits, filling of slide areas will be carried out under supervision of District staff and constitute rebuilding of the affected portion of the embankment. Immediate treatment in urgent situations will consist of filling slide areas with sandbags, riprap or other available materials. The methods used would be the same as those discussed in Section B-5 and B-6.

B-10. Emergency Operations and Repairs - Threatened Sabotage

a. Potential Problems

Threats of sabotage are most likely to be received from individuals or groups whose actual intent of carrying through with the threatened action is not known. However, all such threats are to be taken seriously. Threats considered most probable to occur are those related to disruption of communications, blocking access to the project, and interference with project operations. Threats could also relate to damaging the embankment or other key project features affecting safety.

b. Corrective Action

(1) All threats concerning the Pokegama Dam and Reservoir will be reported immediately to the Federal Bureau of Investigation and to the District's Hydraulics and Hydrology Branch. Others should be notified according to Appendix C.

(2) Immediate assistance to secure and protect the dam, dikes and appurtenant facilities will be requested in the event a threatened action could jeopardize the safety of project visitors and staff or downstream areas if carried out. Agencies from which law enforcement assistance can be obtained are listed in Table C-2.

(3) Every effort shall be made to operate the Pokegama Dam and Reservoir so as to avoid injury to all parties. However, the possible catastrophic consequences of dam failure require that actions necessary to maintain the safety of the dam must not be compromised by persons seeking to block access to the site, limit reservoir levels or releases, or otherwise impede essential operations.

B-11. Emergency Operations and Repairs - Sabotage

a. Potential Problems

Acts of sabotage may range from minor disruptions to quasi-military attacks by knowledgeable and well-equipped professionals. The effects of sabotage fall into one of three categories: a) not affecting safety of the dam; b) posing a minor or future safety problem; or c) posing an immediate, serious safety problem.

b. Corrective Actions

(1) All acts of sabotage will be reported immediately to the Federal Bureau of Investigation and to the District's Hydraulics and Hydrologic Engineering Branch.

(2) Immediate remedial action shall be initiated in all cases of sabotage causing an imminent or future safety problem of a serious nature. As appropriate, remedial action shall include:

(a) Declaration of an emergency condition and activation of the Notification Subplan (Appendix C).

(b) Activation of the emergency drawdown.

(c) Initiation of emergency repairs according to the nature of damage.

B-12. Inventory of Resources

Resources available at the District level for carrying out emergency operations and repairs are listed in Table B-4. An inventory of available contractors and vendors at the Project Office level is shown on Table B-5.

TABLE B-1

EMERGENCY LABOR REQUIREMENTS - EARTH FILL STRUCTURES [1/]

WORK ELEMENT DESCRIPTION	UNIT	WORKER-DAYS PER UNIT		
		ADVERSE CONDITION	AVERAGE CONDITION	FAVORABLE CONDITION
Excavate and Load	1000 CY	11.2	6.9	2.5
Hauling	1000 YD MI	5.2	3.1	1.4
Spreading and Compacting	1000 CY	18	9	4
Erosion Control: Riprap (12" thick)	1000 CY	22.85	15.0	7.5
For Quick Estimates: Earth fill structure, complete [2/].	1000 CY	54	35	15

Typical crews: 1 crew leader, 3 to 5 laborers plus equipment for clearing and grubbing; 1 worker with equipment excavating and loading; 5 to 15 workers with equipment hauling; 1 crew leader and 3 to 7 laborers spreading and compacting fill; 1 crew leader and 5 to 10 laborers installing erosion control plus equipment and workers hauling materials.

1/ Reference (14)- FM 5-35, Table 16-21.
2/ Includes all clearing, borrowing, hauling, compacting and erosion control.

TABLE B-2

EMERGENCY LABOR REQUIREMENTS - EROSION CONTROL [1/]

WORK ELEMENT DESCRIPTION	UNIT	WORKER - DAYS PER UNIT ADVERSE CONDITION	AVERAGE CONDITION	FAVORABLE CONDITION
Machine Work:				
Sloping shoulders, banks and ditches	1000 SY YD MI	4.0	2.6	1.3
Hauling riprap or rubble	1000 YD MI	5.2	3.1	1.4
Placing riprap or rubble (12" thick)	1000 CY	18	12	6
Hand Work:				
Sloping shoulders banks and ditches	1000 SY	33	22	11
Placing riprap or rubble	SY	0.09	0.06	0.03
For quick estimates:				
Erosion control - riprap (12" thick)	1000 SY	22.5	15.0	7.5

Typical crew: Sloping shoulders, banks and ditches - 1 to 2 operators on equipment, or 1 crew leader and 3 to 8 laborers with hand tools.

Typical crew: Grass - 1 crew leader, 6 to 20 laborers plowing, harrowing, fertilizing, digging sprigs, hauling sprigs, scattering sprigs, disking, seeding and watering.

Typical crew: Riprap - 1 crew leader and 6 to 20 laborers hauling and placing riprap.

[1/] Reference (14) - FM 5-35, Table 16-42.

TABLE B-3

EMERGENCY LABOR REQUIREMENTS - GENERAL EXCAVATION [1/]

WORK ELEMENT DESCRIPTION	UNIT	WORKER - DAYS PER UNIT ADVERSE CONDITION	AVERAGE CONDITION	FAVORABLE CONDITION
Machine Work:				
Excavating (no trim nor handwork)	1000 CY	25	12	6
Loading	1000 CY	9.0	4.5	2.0
Hauling	1000 YD MI	5.2	3.1	1.4
Spreading	1000 CY	4.9	3.0	1.5
Backfilling	1000 CY	9	6	3
Compacting	1000 CY	12	8	4
Grading	1000 CY	1.6	0.8	0.4
Handwork:				
Excavating	CY	1.2	0.7	0.3
Loading	CY	0.8	0.4	0.2
Spreading	CY	0.18	0.12	0.06
Backfilling	CY	0.35	0.20	0.10
Compacting	CY	0.35	0.35	0.15
Shoring Walls of Excavation	1000 SF	40	24	8

Typical crew: Machine work - 1 crew leader, 2 operators excavating, 2 to 6 operators on hauling equipment, 1 operator on spreading and backfilling equipment; 1 operator on compacting equipment, and 1 operator on grading equipment.

Typical crew: Handwork - 1 crew leader, 2 to 10 workers excavating, loading, spreading backfilling, compacting, trimming, and fine grading.

Typical crew: Shoring - 2 or more workers.

[1/] Reference (14) - FM 5-35, Table 16-20.

TABLE B-4

INVENTORY OF RESOURCES - DISTRICT LEVEL

Name of Resource	Type of Resource	Address	Phone Number
Brisson Pump Company	Pump Distributor	2359 E. Cowern Place N. St. Paul, MN 55109	(612) 777-3317
Tecumseh Products Company	Pump Distributor	P.O. Box 355 223 Curtis Street Delaware, OH 43015	(614) 369-9656
Kasten Schmidt Equipment Systems	Pump Distributor	455 Whitrock Avenue Wisconsin Rapids, WI 54494	(715) 423-9221
The Crisafulli Pump Company, Inc.	Pump Distributor	Box 1051 Glendive, MT 59330	(406) 365-3393
Gator Pump, Inc.	Pump Distributor	P.O. Box 57 302 Corrigan Brownwood, TX 76801	1-800-351-1463
Cherne Industries, Inc.	Sewer Plugs/ Pipe Stoppers	5701 S. County Road 18 Minneapolis, MN 55436	(612) 933-5501
NB Products	Sewer Plugs/ Pipe Stoppers	35 Bevlah Road New Britain, PA 18901	(215) 345-1879
Goodyear Tire and Rubber Company	Sewer Plugs/ Pipe Stoppers	5100 West 35th Street Minneapolis, MN 55416	(612) 927-7381
Carlson Equipment Company	Sewer Plugs/ Pipe Stoppers	1380 W. County Road C St. Paul, MN 55113	(612) 633-8171

TABLE B-4 (Continued)

INVENTORY OF RESOURCES - DISTRICT LEVEL

Name of Resource	Type of Resource	Address	Phone Number
Mac Katz Bag Co., Inc (includes polythylene sheeting)	Sandbags	P.O. Box 1666 Indianapolis, IN 46206-1666	(317) 635-9561
Independent Manufacturers Marketing Service	Sandbags	1543 Holton Street St. Paul, MN 55108	(612) 644-2007
Berg Bag Company	Sandbags	410 3rd Avenue North Minneapolis, MN 55401	(612) 922-3286
Volm Bag Company	Sandbags	2200 Mary Hills Drive Golden Valley, MN 55345	(612) 935-8222
Central Bag Company	Sandbags	1323 W. 13th St. P.O. Box 4044 Kansas City, MO 64101	(816) 471-0388
Dan-Dee Equipment, Inc.	Sandbagging Equipment	P.O. Box 125 Honey Creek, WI 53138	(414) 534-3138
Bemis Company, Inc. Packaging Service	Sandbagging Equipment	315 27th Ave N.E. Minneapolis, MN 55418	

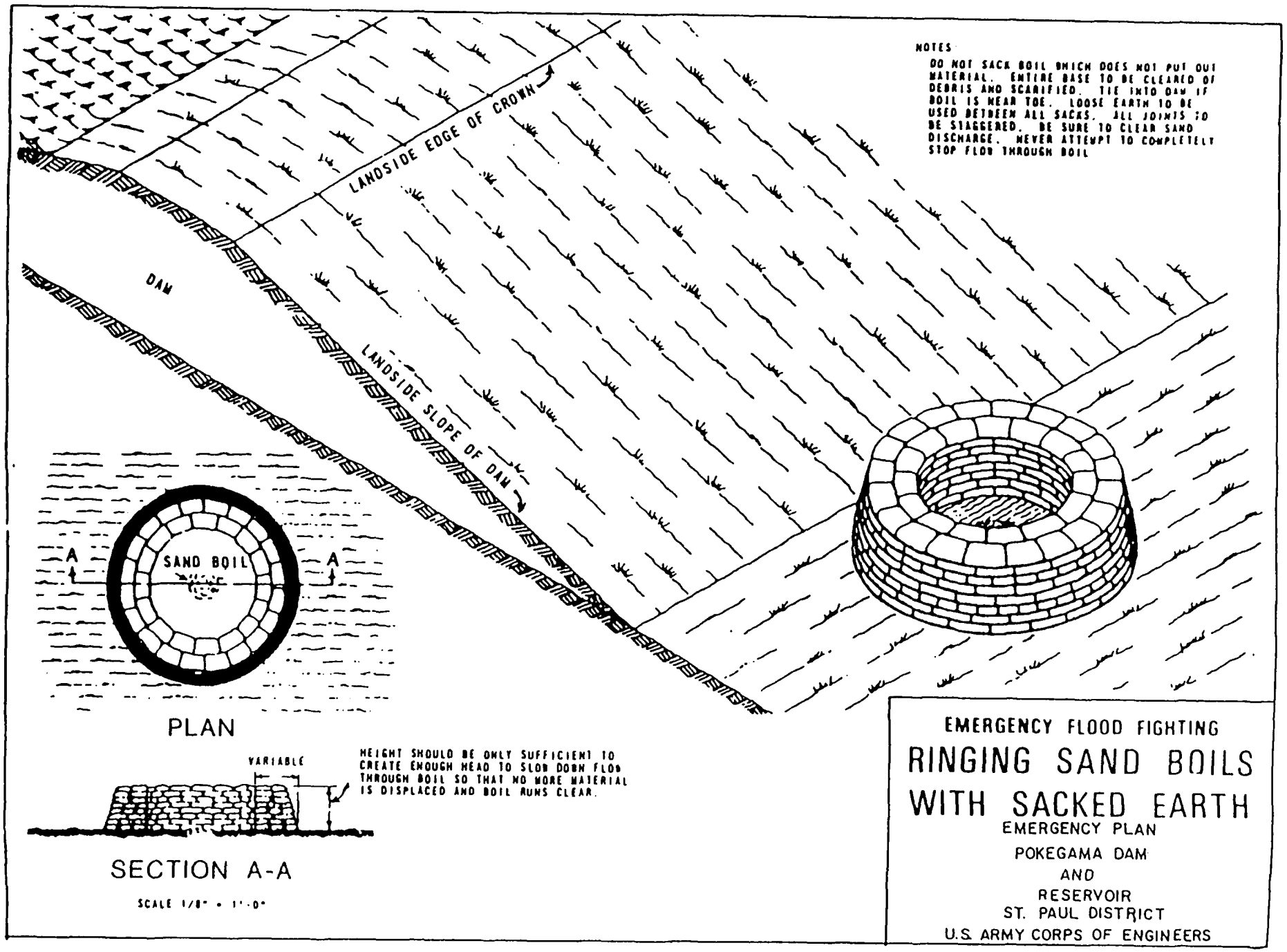
TABLE B-5

INVENTORY OF LOCAL CONTRACTORS AND VENDORS - PROJECT OFFICE LEVEL

NAME OF CONTRACTOR/VENDOR	TYPE OF SERVICE	ADDRESS/PHONE NUMBER
Casper Construction Co., Inc.	Contractor	212 SE 10th Street Grand Rapids, Minnesota 55744 (218) 326-9637
Hawkinson Construction Co., Inc.	Contractor	1714 NW 3rd Street Grand Rapids, Minnesota 55744 (218) 326-3569
Eagle Contracting Company	Contractor	Remer, Minnesota 56672 (218) 566-1454
Peterson Excavating, Inc.	Excavation	Federal Dam, Minnesota 56641 (218) 654-5282

The following is a list of resources available at the Pokegam Dam project office.

2 Dodge 3/4 ton trucks
1 Boat with trailer, 16 ft.
1 International loader
1 J.D. 318 garden tractor
1 Johnson outboard, 10 hs..
1 Welder, Miller 250 twin
1 Reddy heater, 50,000 btu
1 Gas torch
1 Wheel borrow
1 Sears drill press, 13.5"
3 pr. Waders
1 Mall, 13 lbs.
2 Garden Rakes
2 Short handle spades
3/8" Rope, 300 feet
1 Battery charger/booster, 60 amp
1 International 58 horse tractor
1 Massey Ferguson rear blade
1 J.D. 68 riding lawn mower
1 Mercury outboard, 9.9 hs.
1 Portable gas generator, Kohler
1 Sears air compressor, 8.8 cfm
1 Homelite pump, 83 g.p.m.
1 Craftsman table saw
1 Bench grinder
1 pr. Hip boots
2 Axes
2 pick axes
4 Long handle spades
2 Short handle scoop shovels



EMERGENCY FLOOD FIGHTING

RINGING SAND BOILS WITH SACKED EARTH

EMERGENCY PLAN

POKEGAMA DAM

AND

RESERVOIR

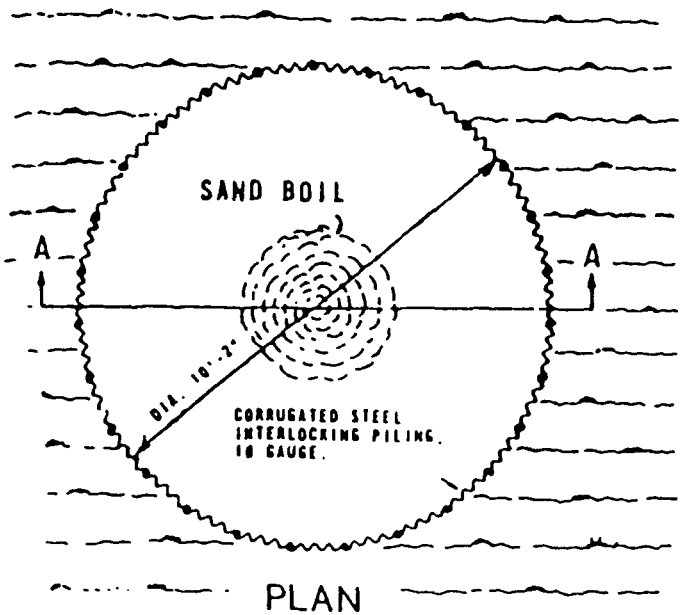
ST. PAUL DISTRICT

U.S. ARMY CORPS OF ENGINEERS

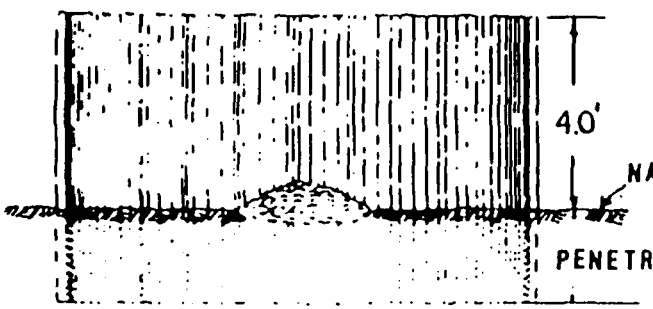
PLATE B-1

EMERGENCY FLOOD FIGHTING
RINGING SAND BOILS WITH STEEL PILING
EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

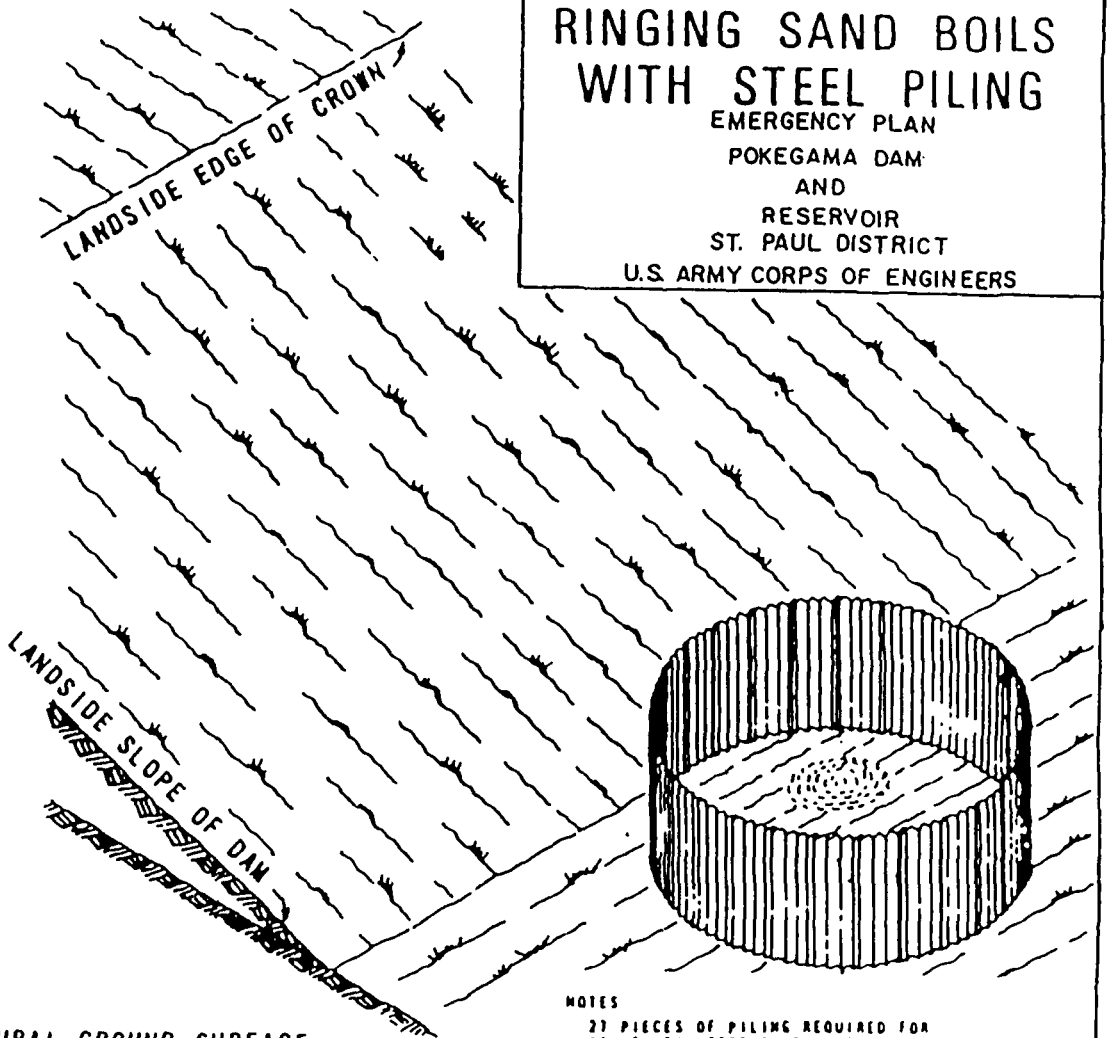
NOTE:
DRIVING CAPS WILL BE USED. DRIVING MAY BE EFFECTED EITHER BY MECHANICAL OR HAND METHOD.



PLAN



SECTION A-A



NOTES
27 PIECES OF PILING REQUIRED FOR 10'-2" DIAMETER RING WHICH SHOULD BE ADEQUATE FOR MOST SAND BOILS
DO NOT RING BOIL WHICH DOES NOT PUT OUT MATERIAL
ENTIRE AREA TO BE CLEARED OF DEBRIS
BE SURE TO CLEAR SAND DISCHARGE
NEVER ATTEMPT TO COMPLETELY STOP FLOW THROUGH BOIL

PLATE B-2

TIME REQUIRED TO CONSTRUCT SANDBAG RINGS OF VARIOUS SIZES

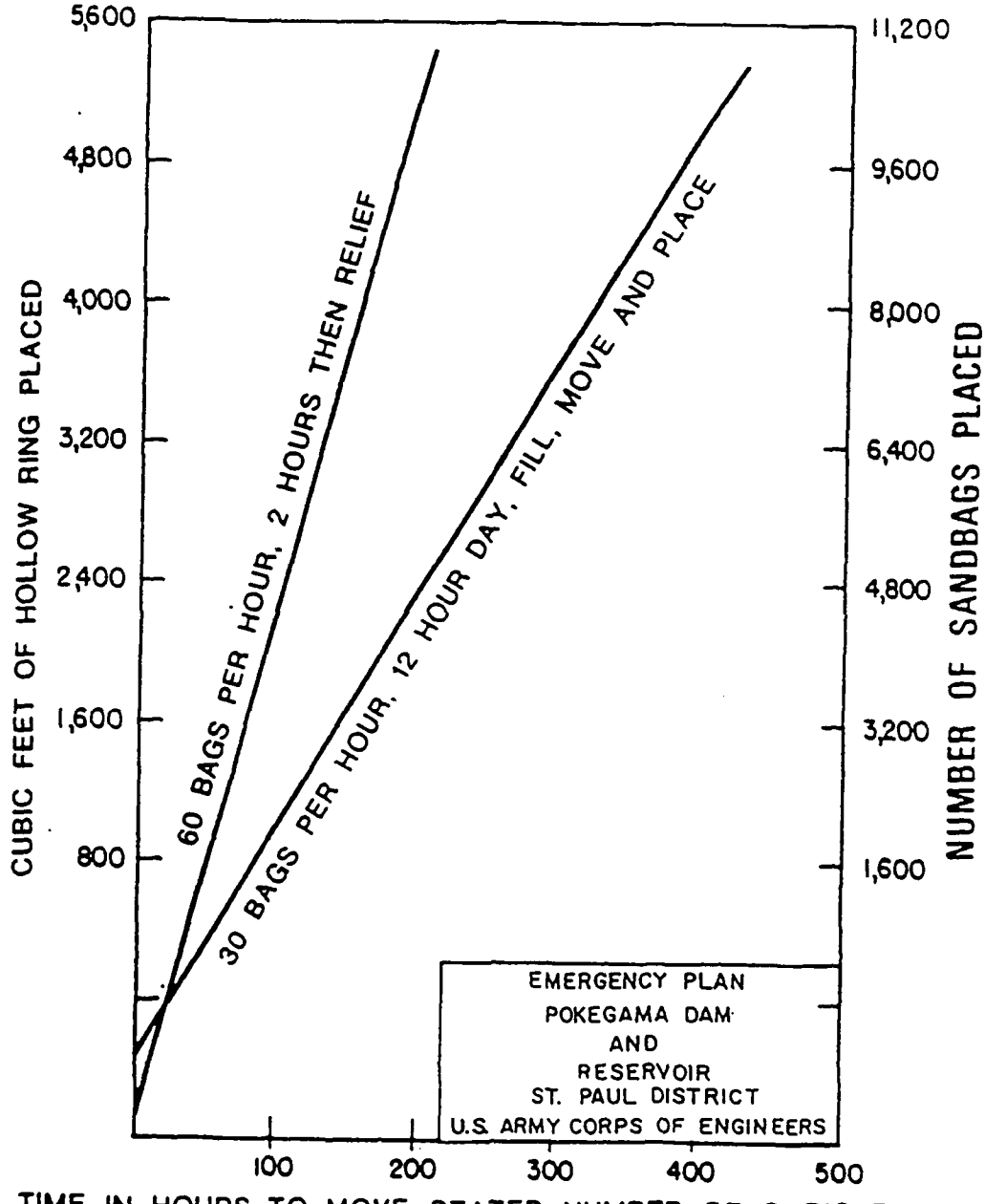
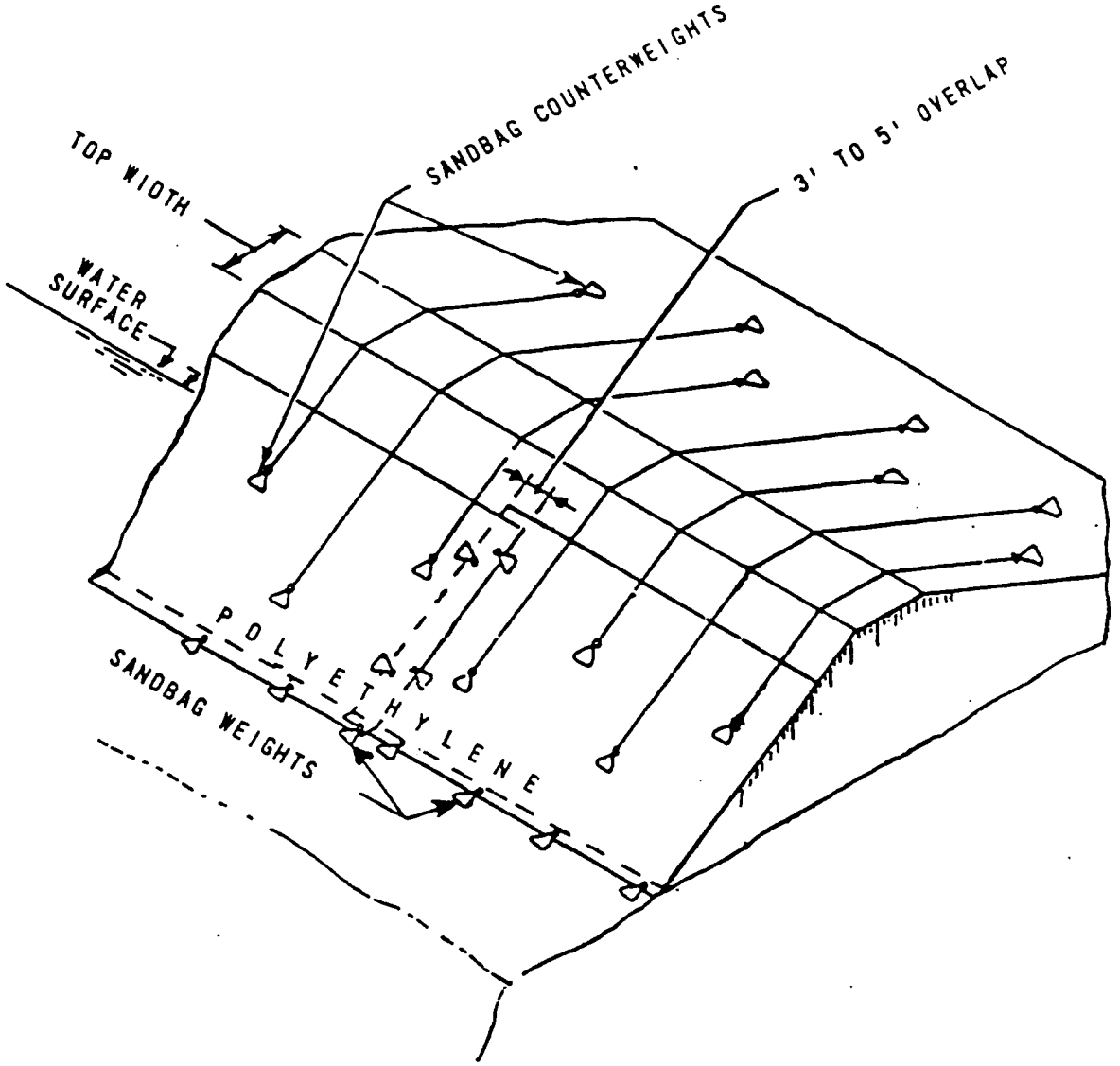


PLATE B-3



EMERGENCY FLOOD FIGHTING

PLACEMENT OF POLYETHYLENE SHEETING IN THE WET

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

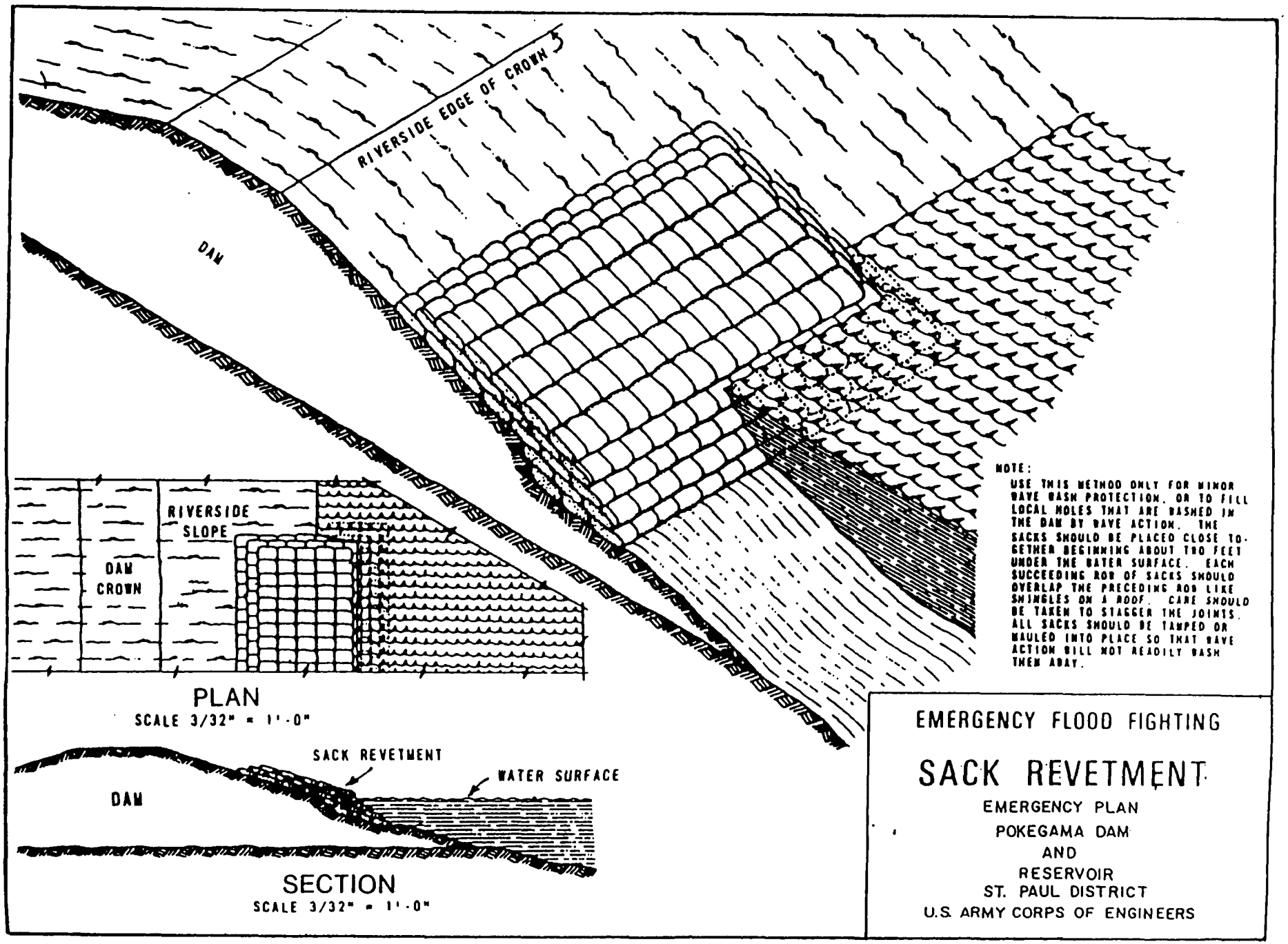
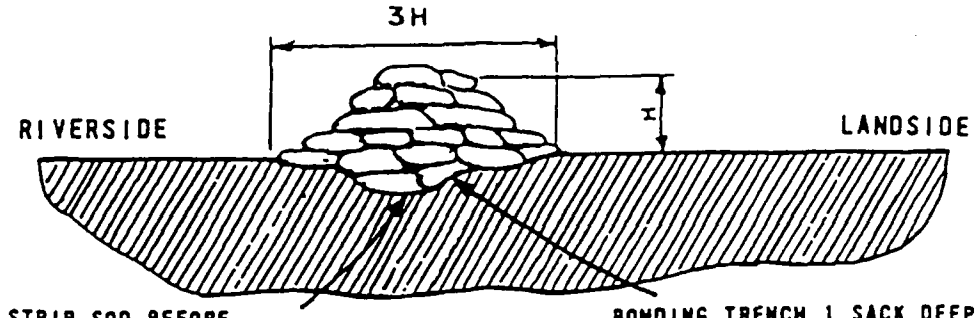

RIVERSIDE EDGE OF CROWN
DAM
RIVERSIDE SLOPE
DAM CROWN
PLAN
SCALE 3/32" = 1'-0"
SACK REVETMENT
WATER SURFACE
DAM
SECTION
SCALE 3/32" = 1'-0"
NOTE:
USE THIS METHOD ONLY FOR MINOR WAVE WASH PROTECTION, OR TO FILL LOCAL HOLES THAT ARE WASHED IN THE DAM BY WAVE ACTION. THE SACKS SHOULD BE PLACED CLOSE TOGETHER BEGINNING ABOUT TWO FEET UNDER THE WATER SURFACE. EACH SUCCEEDING ROW OF SACKS SHOULD OVERLAP THE PRECEDING ROW LIKE SHINGLES ON A ROOF. CARE SHOULD BE TAKEN TO STAGGER THE JOINTS. ALL SACKS SHOULD BE TAMPED OR HAULED INTO PLACE SO THAT WAVE ACTION WILL NOT READILY WASH THEM AWAY.
EMERGENCY FLOOD FIGHTING
SACK REVETMENT
EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-5



SECTION

NOTE:

ALTERNATE DIRECTION OF SACKS WITH BOTTOM LAYER PARALLEL TO FLOW, NEXT LAYER PERPENDICULAR TO FLOW, ETC.

LAP UNFILLED PORTION UNDER NEXT SACK.

TYING OR SEWING SACKS NOT NECESSARY..

TAMP THOROUGHLY IN PLACE..

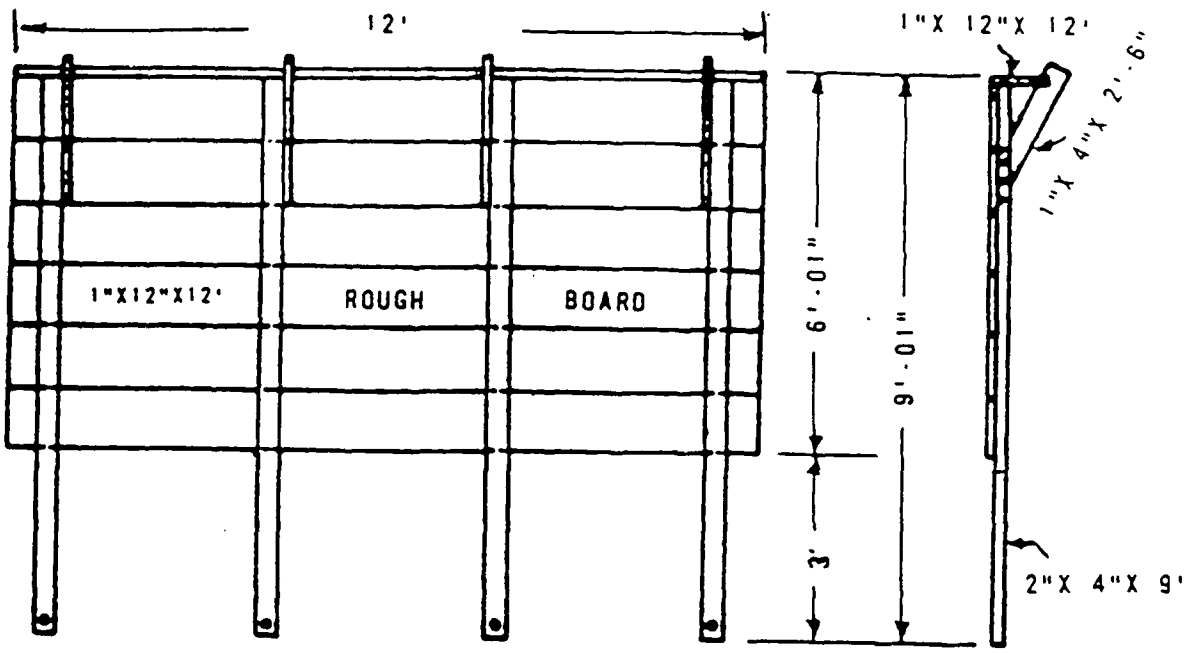
SACKS SHOULD BE APPROXIMATELY 1/2 FULL OF SAND.

METHOD OF LAPPING SACKS

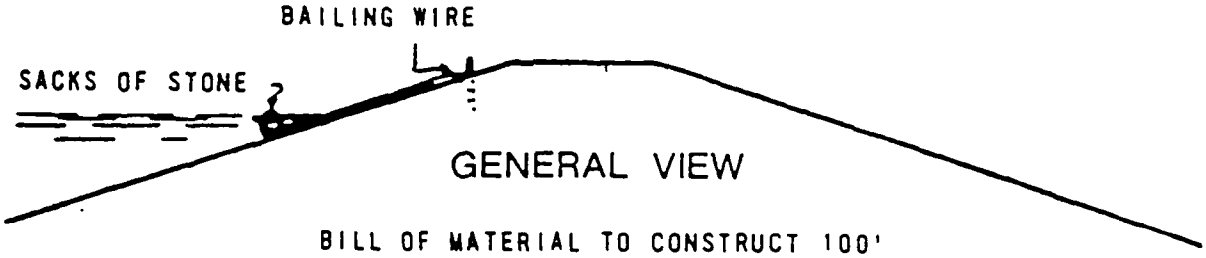
EMERGENCY FLOOD FIGHTING

SANDBAG BARRIER

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS



PLAN ELEVATION



GENERAL VIEW

BILL OF MATERIAL TO CONSTRUCT 100'

56 PCS. 1"X 12"X 12'	32 PCS. 1"X 4"X 2'-6"
32 PCS. 2"X 4"X 9'	32 PCS. 2"X 4"X 2'

PERSONNEL REQUIRED FOR PLACING PLANKS -
4.2 - 5.8 WORKERS HOURS PER 100 SQUARE FEET.

EMERGENCY FLOOD FIGHTING

TYPE OF MOVABLE WAVE WASH PROTECTION

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

ENGINEERING PROPERTIES OF VARIOUS SOIL TYPES[1]

Typical Names of Soil Groups	Group Symbols	Important Properties			
		Permeability when Compacted	Shearing Strength when Compacted and Saturated	Compressibility when Compacted and Saturated	Workability as a Construction Material
Well-graded gravels, gravel-sand mixtures, little or no fines	*GW*	pervious	excellent	negligible	excellent
Poorly graded gravels, gravel-sand mixtures, little or no fines	*GP*	very pervious	good	negligible	good
Silty gravels, poorly graded gravel-sand-silt mixtures	*GM*	*semipervious to impervious*	good	negligible	good
Clayey gravels, poorly graded gravel-sand-clay mixtures	*GC*	impervious	good to fair	very low	good
Well-graded sands, gravelly sands, little or no fines	*SW*	pervious	excellent	negligible	excellent
Poorly graded sands, gravelly sands, little or no fines	*SP*	pervious	good	very low	fair
Silty sands, poorly graded sand-silt mixtures	*SM*	semipervious to impervious	good	low	fair
Clayey sands, poorly graded sand-clay mixtures	*SC*	impervious	good to fair	low	good
Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	*ML*	semipervious to impervious	fair	medium	fair
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	*CL*	impervious	fair	medium	good to fair
Organic silts and organic silt-clays of low plasticity	*OL*	semipervious to *impervious*	poor	medium	fair
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	*MH*	semipervious to impervious	fair to poor	high	poor
Inorganic clays of high plasticity, fat clays	*CH*	impervious	poor	high	poor
Organic clays of medium to high plasticity	*OH*	impervious	poor	high	poor
Peat and other highly organic soils	*Pt*	—	—	—	—

1. Reference (15) - Soil Mechanics, Lambe T. W. and R. V. Whitman

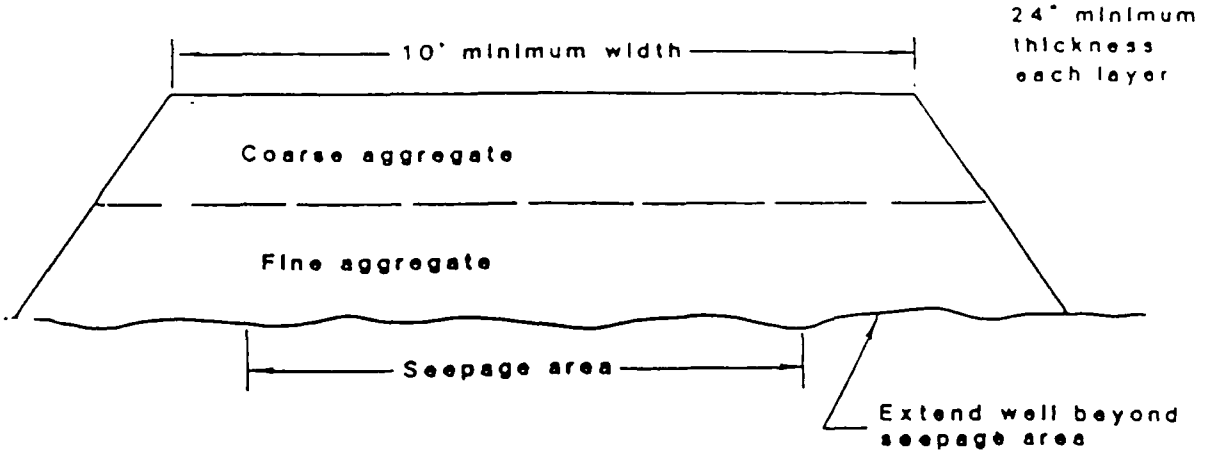
USES OF VARIOUS SOIL TYPES[1]

Typical Names of Soil Groups	Group Symbols	Relative Desirability for Various Uses									
		Rolled Earth Dams			Canal Sections		Foundations		Roadways		
									Fills		
		Homogeneous Embankment	Core	Shell	Erosion Resistance	Compacted Earth Lining	Seepage Important	Seepage not Important	Frost Heave not Possible	Frost Heave Possible	Surfacing
Well-graded gravels, gravel-sand mixtures, little or no fines	*GW*	—	—	1	1	—	—	1	1	1	3
Poorly graded gravels, gravel-sand mixtures, little or no fines	*GP*	—	—	2	2	—	—	3	3	3	—
Silty gravels, poorly graded gravel-sand-silt mixtures	*GM*	2	4	—	4	4	1	4	4	9	5
Clayey gravels, poorly graded gravel-sand-clay mixtures	*GC*	1	1	—	3	1	2	6	5	5	1
Well-graded sands, gravelly sands, little or no fines	*SW*	—	—	3 if gravelly	6	—	—	2	2	2	4
Poorly graded sands, gravelly sands, little or no fines	*SP*	—	—	4 if gravelly	7 if gravelly	—	—	5	6	4	—
Silty sands, poorly graded sand-silt mixtures	*SM*	4	5	—	8 if gravelly	5 erosion critical	3	7	8	10	6
Clayey sands, poorly graded sand-clay mixtures	*SC*	3	2	—	5	2	4	8	7	6	2
Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	*ML*	6	6	—	—	6 erosion critical	6	9	10	11	—
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	*CL*	5	3	—	9	3	5	10	9	7	7
Organic silts and organic silt-clays of low plasticity	*OL*	8	8	—	—	7 erosion critical	7	11	11	12	—
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	*MH*	9	9	—	—	—	8	12	12	13	—
Inorganic clays of high plasticity, fat clays	*CH*	7	7	—	10	8 volume change critical	9	13	13	8	—
Organic clays of medium to high plasticity	*OH*	10	10	—	—	—	10	14	14	14	—
Peat and other highly organic soils	*Pt*	—	—	—	—	—	—	—	—	—	—

For a landside berm a GW or GP soil would work best, if available. If such a soil is not readily available, an SP or SW soil could be used (if gravelly) for the lower layer of the blanket with a coarse gravel or rock blanket on top. Depending upon the site, adequate material may not be available. If materials for emergency repair of the dam are not readily available at the site, it may be desirable to haul the materials in advance and stockpile them in a safe location with proper protection.

1. Reference (15) - Soil Mechanics, Lambe T. W. and R. V. Whitman

PLATE B-9



GRANULAR BLANKET

APPROXIMATE CONSTRUCTION REQUIREMENTS

Blanket Area ($ft.^2$)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
Material Req'd Per Layer ($yd.^3$)	40	80	120	150	190	225	270	300	330	370
No. Trucks & Drivers	3	3	6	6	6	8	10	10	12	12
No. Graders & Operators	5	5	10	10	15	15	15	20	20	20
Total Time Req'd. (Hrs.)	4	8	6	8	8	8	8	8	9	10

EMERGENCY FLOOD FIGHTING

GRANULAR BLANKET

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-10

EMERGENCY NOTIFICATION SUBPLAN

APPENDIX C

TO

EMERGENCY PLAN

FOR

POKEGAMA DAM AND RESERVOIR

MARCH 1987

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C-7	Timing of Notifications	C-5
C-8	Content of Notification Messages	C-5
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C-11	Example Messages	C-11

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C-2	Key Contacts for Emergency Notifications (External)	C-15
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EMERGENCY NOTIFICATION SUBPLAN

POKEGAMA DAM AND RESERVOIR

C-1. Introduction

Conditions affecting operation of Pokegama Dam and Reservoir could result in a hazard to life and/or property due to high reservoir levels or sudden release of large volumes of water. Prompt issuance of appropriate notifications is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for issuing notifications of impending and existing emergencies affecting the operation and safety of Pokegama Dam and Reservoir.

b. Scope

This subplan specifies notifications and other actions to be taken upon declaration of a pre-emergency or emergency condition. Notifications and actions specified are those necessary for:

(1) Ensuring safety.

(2) Vacating project areas where emergency operations and repairs may be conducted.

(3) Internal coordination of Corps of Engineers activities.

(4) Coordination with non-federal units of government and other Federal agencies

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of Pokegama Dam and Reservoir.

C-2. Definitions

a. Pre-emergency

A "pre-emergency" condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected to occur.

b. Emergency

An "emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an emergency condition may be imminent or longer term.

c. Park Manager

The term "Park Manager" means the individual in charge at the Pokegama Dam project site.

d. Mississippi Headwaters Project Office

The term "Mississippi Headwaters Project Office" means the person in charge of the Mississippi Headwaters Project Office.

e. District

The term "District" identifies one of the following elements depending upon which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the pre-emergency or emergency situation. Also responsible for keeping the Dam Safety Committee, and the NCD Dam Safety Officer informed of the pre-emergency or emergency situation.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the pre-emergency or emergency situation. Also responsible for matters involving normal dam operations and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. Provides a 24-hour telephone contact with the District Office. Responsible for keeping the Dam Safety Officer, the Commander/District Engineer, and NCD in contact with the operations and personnel. Also responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving reservoir regulation.

(5) Geotechnical Design Section. A section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the structural integrity of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the outlet structures.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support, and matters involving environmental analysis and cultural resources.

C-3. Basis of Activation

This subplan is to be activated immediately upon declaration of a pre-emergency or emergency condition.

C-4. Parties to be Notified

a. Corps Offices

Corps offices to be notified of all pre-emergency or emergency conditions that are declared are listed in Table C-1.

b. Other Parties

Other parties to be notified according to the nature of an emergency or pre-emergency condition are listed in Table C-2.

c. For High Pool Levels

Additional parties to be notified in the event of anticipated high pool levels are listed in Table C-3.

C-5. Responsibility for Notifications

Notifications listed in Tables C-1 and C-2 are the responsibility of the office (Park Manager, Mississippi Headwaters Project Office or District) making the declaration of a pre-emergency or emergency condition. Assistance in making notifications may be requested from other Corps offices and/or other parties. In the event all communications between offices are disrupted after declaration of a pre-emergency or emergency condition, each office will assume responsibility for making all notifications.

C-6. Communications

a. Corps Offices

(1) Normal

Communications between the District and Park Manager, are normally by radio. Radios at the project administration office and District's Emergency Operations Center will be manned on a 24-hour basis during all flood emergencies and whenever a pre-emergency or emergency condition is in effect. (Office and home phone numbers of key Corps personnel are listed in Table C-1).

(2) Back-Up

The telephone communications network between the District Office, project administration office and Mississippi Headwaters Project Office will be used to back-up radio communications. Telephones at each office will be manned as required during all flood emergencies and whenever a pre-emergency or emergency condition is in effect and radio service is disrupted. Information on radio frequencies and call letters for key contacts are listed in Table A-1.

(3) Emergency

During a situation when both radio and telephone communications between the District Office and project area are lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are identified in Table C-1 along with telephone information.

b. Other Parties

(1) Normal

Communications with other parties will normally be by telephone. Office and home phone numbers of key contacts are listed in Table C-2.

(2) Back-Up

Communications with other parties will be by radio in the event telephone service is disrupted. The table also lists those parties which can be requested to forward notifications to offices lacking radio equipment.

c. High Pool Levels

Additional parties to be notified in the event of anticipated high pool levels are listed in Table C-3.

C-7. Timing of Notifications

Parties listed in Table C-1 are to be notified as soon as possible after declaration of a pre-emergency or emergency condition. Notifications listed in Tables C-2 and C-3 are dependent on reservoir water elevation and other conditions and should be made as soon as a high probability of the eventual need for notification is predicted.

C-8. Content of Notification Messages

a. Corps Offices

Notifications are to include the key information needed as a basis for decision making and/or action including, as appropriate and to the extent possible, the following:

(1) Description of Situation

(a) Nature and severity of problem(s).

(b) Current and predicted reservoir conditions including water elevation, inflow and discharge.

(c) Current and forecasted weather conditions.

(2) Action Planned or Underway

(a) Type of corrective actions.

(b) Estimated time to complete corrective actions.

(c) Outlook for success.

(d) Assistance required/being furnished.

(e) Potential complications.

(f) Recommended evacuation.

(3) Other

(a) Staff at dam site.

(b) Visitors at project.

(c) Road conditions.

b. Other Parties

Notification messages are to include a description of the nature of impending or existing hazard, potential timing of its occurrence, and recommendations for evacuation and other action (needed evacuation on project lands managed by the Corps will be directed rather than recommended).

C-9. Pre-emergency Actions

a. Park Manager

For a Park Manager declared or suspect pre-emergency situation, the Park Manager must notify the Mississippi Headwaters Project Office in accord with paragraph C-5, Table C-1 and Figure C-1.

If contact with the Mississippi Headwaters Project Office cannot be made, contact the Dam Safety Officer, Project Operations Branch, and Emergency Operations Center as shown in Table C-1 and Figure C-1

b. Mississippi Headwaters Project Office

Evaluate the situation and declare a pre-emergency condition if warranted.

Notify Dam Safety Officer, Project Operations Branch, and Emergency Operations Center in accord with paragraph C-5, Table C-1 and Figure C-1.

Provide assistance as needed to Park Manager and District Office.

c. District

(1) Dam Safety Officer

(a) The Dam Safety Officer is to be kept informed of all conditions of the pre-emergency situation.

(b) Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency situation.

(c) Evaluate the situation and declare a pre-emergency condition if warranted.

(d) Notify the North Central Division Dam Safety Officer in accord with paragraph C-5 if pre-emergency condition was declared by the Park Manager, Mississippi Headwaters Project Office, or District Office.

(e) Notify the Dam Safety Committee, the emergency Operations Center and the Project Operations Branch of the situation.

(2) Project Operations Branch

(a) Must be kept informed of all pre-emergency situations.

(b) Responsible for identifying a person-in-charge of the pre-emergency situation. Also, responsible for matters involving normal Dam operations and/or any other matters not covered by other District elements.

(c) Responsible for contacting the Dam Safety Officer for engineering and technical assistance and keeping him informed of the situation. Also, contact the Emergency Operations Center and keep them informed of the situation.

(d) Evaluate the situation and declare a pre-emergency condition if warranted.

(e) Provide needed assistance and/or instructions to the Mississippi Headwaters Project Office, Park Manager and person-in-charge of the pre-emergency situation.

(3) Emergency Operations Center

(a) Twenty-four (24) hour telephone service.

(b) Must be kept informed of all pre-emergency situations.

(c) Responsible for contacting Dam Safety Officer, Project Operations Branch, District Engineer, Public Affairs, and the NCD Emergency Manager.

(d) Responsible for matters involving National Security, Disasters, and Mobilization. Provide Emergency response in accordance with ER 500-1-1, National Disaster Procedures.

(e) Evaluate the situation and declare a pre-emergency condition if warranted.

(4) Others

The district personnel listed under this category in Table C-1 are only to be contacted if none of the above District Elements could be reached.

(a) Evaluate the pre-emergency conditions and declare a pre-emergency condition if warranted. Notify the Dam Safety Officer, the Emergency Operations Center and the Project Operations Branch as soon as possible.

(b) If the Project Operations Branch cannot be contacted, appoint a temporary person-in-charge of the pre-emergency situation.

(c) Provide needed assistance and/or instructions to Mississippi Headwaters Project Office, Park Manager and person-in-charge of the pre-emergency situation.

C-10. Emergency Actions

a. Park Manager

(1) For a Park Manager declared emergency or suspect emergency situation, the Park Manager must notify the Mississippi Headwaters Project Office in accord with paragraph C-5, Table C-1 and Figure C-1.

If contact with the Mississippi Headwaters Project Office cannot be made, contact the Dam Safety Officer, Project Operations Branch, and Emergency Operations Center as shown in Table C-1 and Figure C-1.

(2) Cancel normal work schedule and provide for 24-hour duty as needed.

(3) Assess project areas which are or may become unsafe including but not limited to:

(a) Reservoir water surface.

(b) Day use and recreational areas within project boundaries including those managed by others.

(4) Identify areas required for conduct of emergency operations and repairs including any necessary access routes.

(5) Take action to notify and evacuate areas which are unsafe, potentially unsafe, or where emergency operations and repair work may be carried out including, as appropriate:

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Moving equipment to safe areas.

(6) Request assistance as needed in carrying out items (5)(a) and (5)(b) from agencies listed in Table C-2.

(7) Assume District responsibilities for notifications if emergency condition was declared by Park Manager.

(8) Verify appropriate warnings if announced over local radio and television.

b. Mississippi Headwaters Project Office

Evaluate the situation and declare an emergency condition if warranted.

Notify the Dam Safety Officer, Project Operations Branch, and Emergency Operations Center in accord with paragraph C-5, Table C-1 and Figure C-1.

Provide assistance to Park Manager or District as required to accomplish the following tasks:

(1) Cancel normal work schedule and provide for key staff as needed.

(2) Assess project areas which are or may become unsafe including but not limited to:

(a) Reservoir water surface.

(b) Day use and recreational areas within project boundaries including those managed by others.

(3) Identify areas required for conduct of emergency operations and repairs including any necessary access routes.

(4) Take action to notify and evacuate areas which are unsafe, potentially unsafe, or where emergency operations and repair work may be carried out including, as appropriate:

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Moving equipment to safe areas.

(5) Request assistance as needed in carrying out items (4)(a) and (4)(b) from agencies listed in Table C-2.

(6) Assume District responsibilities for notifications if emergency condition was declared by Park Manager.

(7) Verify that appropriate warnings are announced over local radio and television.

c. **District**

(1) Dam Safety Officer

The Dam Safety Officer is to be kept informed of all conditions of the emergency situation.

(a) Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the emergency situation.

(b) Evaluate the situation and declare an emergency condition if warranted.

(c) Notify the North Central Division Dam Safety Officer in accord with paragraph C-5 if an emergency condition was declared by the Park Manager, Mississippi Headwaters Project Office, or District Office.

(d) Notify the Dam Safety Committee, the Emergency Operations Center and the Project Operations Branch of the situation.

(2) Project Operations Branch

(a) Must be kept informed of all emergency situations.

(b) Responsible for identifying a person-in-charge of the emergency situation. Also, responsible for matters involving normal Dam Operations and/or any other matters not covered by other District elements.

(c) Responsible for contacting the Dam Safety Officer for engineering and technical assistance and keeping him informed of the situation. Also, contact the Emergency Operations Center and keep them informed of the situation.

(d) Evaluate the situation and declare an emergency condition if warranted.

(e) Provide needed assistance and/or instructions to the Mississippi Headwaters Project Office, Park Manager and person-in-charge of the emergency situation.

(f) Cancel normal work schedule and provide for key staff as needed.

(g) Determine which of the two planning conditions (PMF without failure or PMF with failure) best represents potential inundation and needs for evacuation.

(h) Determine need for warning of high reservoir levels.

(i) Formulate and issue warning message(s) to affected non-federal parties in accord with paragraph C-6.

(j) Verify appropriate warnings as released over local radio and television.

(3) Others

The District personnel listed under this category in Table C-1 are only to be contacted if none of the above District personnel could be reached.

(a) Evaluate the emergency conditions and declare an emergency condition if warranted. Notify the Dam Safety Officer, the Emergency Operations Center and the Project Operations Branch as soon as possible.

(b) If the Project Operations Branch cannot be contacted, appoint a temporary person-in-charge of the emergency situation.

(c) Provide needed assistance and/or instructions to Mississippi Headwaters Project Office, Park Manager and person-in-charge of the emergency situation.

d. North Central Division

Notify the Office of the Chief of Engineers and other Federal agencies as appropriate.

e. Office of the Chief of Engineers

Notify other Federal agencies as appropriate, such as the Federal Emergency Management Agency.

C-11. Example Messages

Preparation of warning messages should begin as soon as their potential need is apparent so that they can be issued promptly upon declaration of an emergency condition. When time is available, all public notices should be released by the Public Affairs Office or contact Emergency Management or the Hastings Electronic Service Center, if the P.A.O. cannot be reached (Table C-1). In some cases, an emergency condition may be declared with little or no advance notice. The following example messages provide a model for the first announcements in such cases. The Public Affairs Office would then be contacted as soon as time permits. They would release subsequent announcements to provide additional details.

a. **Announcement for Slowly Developing Conditions**

THE ARMY CORPS OF ENGINEERS AT ST. PAUL ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTS AT (Name of Dam) DAM DUE TO (general description of problem). THE DAM IS LOCATED ON (stream) ABOUT (distance) MILES UPSTREAM OF (name of downstream community and state).

A CORPS SPOKESMAN SAID THAT THE WATER LEVEL OF (Name of Reservoir) WAS BEING LOWERED (as a precautionary measure/to reduce pressure on the dam/to enable repair work). THE SPOKESMAN EMPHASIZED THAT THE DRAWDOWN OF THE POOL WAS BEING CARRIED OUT UNDER CONTROLLED CONDITIONS AND THERE IS NO IMMEDIATE DANGER OF THE DAM FAILING. HOWEVER, THE LARGE RELEASES OF WATER THAT ARE BEING MADE MAY CAUSE FLOODING ALONG (stream). SHOULD (evacuate/be alert for high water and prepare to evacuate).

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

b. **Announcement for Rapidly Developing Conditions**

URGENT: THE ARMY CORPS OF ENGINEERS HAS ANNOUNCED THAT (name of Dam) DAM IS IN IMMINENT DANGER OF FAILURE. THE DAM IS LOCATED ABOUT (distance) MILES UPSTREAM OF (Name of downstream community and state).

ATTEMPTS TO SAVE THE DAM ARE UNDERWAY BUT THEIR SUCCESS CANNOT BE DETERMINED YET. RESIDENTS ALONG THE (stream) SHOULD EVACUATE TO HIGH GROUND IMMEDIATELY. RESIDENTS ALONG THE (stream) IN THE VICINITY OF (city) AND DOWNSTREAM SHOULD REMAIN ALERT FOR FURTHER INFORMATION.

IF THE DAM FAILS, WATER WILL TAKE APPROXIMATELY (time) HOURS TO REACH THE LOWER END OF (city, stream, etc.). AREAS CLOSER TO DAM WILL BE FLOODED SOONER.

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

c. **Announcement for High Reservoir Levels**

THE ARMY CORPS OF ENGINEERS AT ST. PAUL ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTS AROUND (name of reservoir) DUE TO EXPECTED HIGH WATER LEVELS. THE LAKE IS LOCATED ON (stream) ABOUT (distance) MILES UPSTREAM OF (community and state).

THE CORPS SPOKESMAN SAID THAT THE WATER LEVEL IN THE LAKE WAS EXPECTED TO REACH ELEVATION (elev) AT (time). DUE TO (general description of problem). THIS WATER LEVEL WILL (describe major effects).

LARGE RELEASES OF WATER ARE BEING MADE FROM THE DAM IN AN ATTEMPT TO CONTROL THE LAKE LEVEL. RESIDENTS OF LOW LYING AREAS ALONG (stream) SHOULD BE ALERT TO POSSIBLE FLOODING AND PREPARE TO EVACUATE.

FURTHER INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

OBSERVER

1. Observer potential dam problem.
2. Gather pertinent facts to describe situation.
3. Assess whether slowly developing, rapidly developing or imminent failure.
4. Notify first available lockmaster in order shown.

(If contact cannot be made with Lockmasters listed below, contact the Dam Safety Officer, Project Operations Branch, or Emergency Operations Center as shown on the attached list.)

DAM SUPERVISOR

	Office	Home Phone	Radio
*Clarence Bernardson	(218)326-6128	(218)326-8166	SSB/FM WUD633
Gregg Struss	(218)326-6128	(218)326-1060	SSB/FM WUD633
Pat Duffney	(218)326-6128	(218)326-4760	SSB/FM WUD633

1. Assess observer's report.
2. Take necessary emergency actions.
3. Notify Area Lockmaster, Dam Safety Officer, Project Operations Branch, or Emergency Operations Center.

AREA PROJECT OFFICE

	Office	Home Phone	Radio
James Ruyak	(218)566-2306	(218)566-1294	SSB/FM WUD639

1. Assess the situtation.
2. Take necessary emergency actions.
3. Notify Dam Safety Officer, Project Operations Branch, or Emergency Operations Center.

2 of 4 3 of 4 4 of 4

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

PROJECT OPERATIONS BRANCH

	Office	Home Phone
Dennis Cin	(612)220-0320	(612)455-6786
Thomas Oksness	(612)220-0322	(612)439-0272
Dennis Erickson	(612)220-0325	(612)452-6850

Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving normal dam operations, and/or matters not covered by other District elements. Project Operations Branch will contact Dam Safety Officer for engineering and technical assistance and keep him informed of situation.

OTHER DISTRICT PERSONNEL

Office	Office	Home Phone	Radio	
Western Flood Control Office				
Timothy Bertschi	(701)232-1894	(701)232-5967	FM	WUD 642
Headwaters Project Office				
James Ruyak	(218)566-2306	(218)566-1294	FM	WUD 639
Mississippi River Project Office				
Richard Otto	(507)895-6341	(507)895-6224	FM	WUD 645
Park Managers				
Eau Galle/ Mathiesen	(715)778-5562	(715)778-4597	FM/SSB	WUD 643
Homme/ Odegaard	(701)845-2970	(701)845-2982	FM/SSB	WUD 636
Baldhill/ Odegaard	(701)845-2970	(701)845-2982	FM/SSB	WUD 636
Lk. Traverse/ Salberg	(612)563-4586	(612)563-4586	FM/SSB	WUD 638
Orwell/ Salberg	(612)563-4586	(612)563-4586	FM/SSB	WUD 638
Lac Qui Parle/ Hanson	(612)269-6303	(612)269-9632	FM/SSB	WUD 630
Sandy/ Daly	(218)426-3482	(218)426-3482	FM/SSB	WUD 632
Pokegama/ Vacant	(218)326-6128	Not Appliable	FM/SSB	WUD 633
Leech Lake/ Zahalka	(218)654-3145	(218)566-1642	FM/SSB	WUD 634
Pine River/ Hermerding	(218)692-4488	(218)692-2118	FM/SSB	WUD 640
Winnibigoshish/ Vacant	(218)246-8107	Not Appliable	FM/SSB	WUD 631
Gull Lake/ Espenson	(218)829-3334	(218)778-4255	FM/SSB	WUD 635

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

DAM SAFETY OFFICER*

	Office	Home Phone
Robert Post	(612)220-0303	(612)437-1316
William Goetz	(612)220-0310	(612)454-3722
Stan Kumpula	(612)220-0304	(612)484-8957

To be informed of all pre-emergency or emergency situations. responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency or emergency situation.

DAM SAFETY COMMITTEE

	Office	Home Phone
William Goetz	(612)220-0310	(612)454-3722
Helmer Johnson	(612)220-0602	(612)633-7791
Robert Engelstad	(612)220-0610	(612)459-6343
Robert Fletcher	(612)220-0510	(612)484-4998
Dennis Cin	(612)220-0320	(612)455-6786
Dale Mazar	(612)220-0444	(612)631-1940
Stan Kumpula	(612)220-0304	(612)484-8957

NCD DAM SAFETY OFFICER*

	Office	Home Phone
Zane Goodwin*	(312)353-6311	(312)823-4606
Carl Cable	(312)353-6372	(312)357-4529
Don Leonard	(312)353-6355	(312)359-3372
Lee Hoglind	(312)353-6358	(312)579-0148

OCE DAM SAFETY OFFICER*

	Office	Home Phone
Lloyd Duscha	(202)272-0382	(703)860-1319
William McCormick	(202)272-0397	(703)569-4323
Jack Thompson	(202)272-0215	(703)978-5627
Edward Prickett	(202)272-0207	(301)865-5876
Robert Smith	(202)272-0220	(703)569-3128
Earl Elker	(202)272-8500	(301)465-2120
John Elmore	(202)272-0196	(703)339-8279
Chief, Hydraulics and Hydrology Division	(202)272-0228	

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

EMERGENCY OPERATIONS CENTER

	Office	Home Phone
District EOC	(612)220-0208	(24-hr. Number)
David Christenson	(612)220-0204	(612)690-5749

Twenty-four (24) hour telephone service. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving national security, disasters, mobilization or NWR flood forecasts. Center will contact Dam Safety Officer, the Commander/District Engineer and NCD.

DISTRICT ENGINEER

	Office	Home Phone
Col. Joseph Briggs	(612)220-0300	(612)894-7142

PUBLIC AFFAIRS OFFICE

	Office	Home Phone
Kennon Gardner	(612)220-0201	(612)884-9023
24-Hr. Answer Machine	(612)220-0200	

NCD EMERGENCY MANAGER

	Office	Home Phone
Natural Disaster Planner Bernard Bochantin	(312)353-5275	(815)568-7544
Chief Emergency Management Tim Monteen	(312)886-8451	(312)961-2195

DISTRICT RADIO

Contact Electronic Service Center at	(612)437-2210	WUD6
SSB Primary		5400Khz
1st Alternate		6020Khz
Emergency		5015KhzLSB

For additional information see Appendix CNCS 500-1-1.

TABLE C-2

KEY CONTACTS FOR EMERGENCY NOTIFICATIONS - EXTERNAL

Cities and Towns	Telephone Office	Residence
Grand Rapids, MN		
Civil Defense Director	(218) 326-3470	
COUNTIES		
Aitkin County, MN		
Civil Defense Director	(218) 927-2102 Ext. 29	(218) 927-2542
Sheriff (24 hour)	(218) 927-2138	
Itasca County, MN		
Civil Defense Coordinator	(218) 327-2878	(218) 832-3902
Sheriff (24 hour)	(218) 326-3477	
Emergency	911	
STATE AGENCIES		
MN Division of Emergency Services	(612) 296-2233	(612) 778-0800
Region II Coordinator	(218) 327-1796	(218) 245-3711
MN Dept. of Natural Resources	(612) 296-2922	
Statewide Emergency Number	1-800-422-0798	
Metro Area	(612) 649-5451	
Backup ONLY	(612) 296-2100	
FEDERAL AGENCIES		
National Weather Service	(612) 725-3401	

TABLE C-3

IDENTIFICATION OF EMERGENCY CONDITIONS AND REQUIRED INTERNAL AND EXTERNAL NOTIFICATIONS

ELEVATION*	PROBLEM	PARTIES TO BE NOTIFIED	ACTION
1. HIGH RESERVOIR LEVEL			
1273.42	Normal pool	Mississippi Headwaters Project Office (MHPO) District	
1273.67	Top summer band		
1274.42	Full pool	MHPO District North Central Division (NCD) National Weather Service (NWS)	Apprise them of situation (for info. only).
2. EMERGENCY DRAWDOWN			
	Possible Failure of Pokegama Dam (Failure not imminent)	MHPO District NCD NWS MN-DES County Civil Defense Coordinators (CCDC)	Apprise them of the situation and that we are increasing discharges.
3. IMMINENT DAM FAILURE			
1278.42	Overtopping of embankment (Failure by overtopping will not come without prior warning in the form of heavy runoff, large inflow and rapidly rising pool levels)	MHPO District NCD Grand Rapids, MN MN-DES CDCC'S NWS	Apprise them of the situation. Use caution/ evacuate. (As appropriate).
	Failure of the embankment	MHPO District	Apprise them of the situation.

*Elevation refers to MSL 1929 adj.

INUNDATION MAP PACKAGE

APPENDIX D

TO

EMERGENCY PLAN

FOR

POKEGAMA DAM AND RESERVOIR

MARCH 1987

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D-4	Inundation Map
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D-6	Inflow, Outflow, and Reservoir Pool Elevation Hydrographs for Probable Maximum Flood "Project With Failure"
D-7	Inflow, Outflow, and Reservoir Pool Elevation Hydrographs for "Failure at Normal High Pool Elevation"
D-8	Comparison of Computed Outflow Rates
D-9	Crest Profiles
D-10	Stage Hydrographs for Probable Maximum Flood Without Failure
D-11	Stage Hydrographs for Probable Maximum Flood With Failure
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INUNDATION MAPS

POKEGAMA DAM AND RESERVOIR

D-1. Introduction

This appendix presents the Inundation Maps and other hydraulic data for the area downstream of the Pokegama Dam for the cases of Probable Maximum Flood without dam failure, Probable Maximum Flood with dam failure and failure at normal high pool level.

D-2. Explanation of Maps

The attached maps indicate the area which would be flooded under the hypothesized conditions of: a) occurrence of a Probable Maximum Flood at Pokegama Dam; and b) occurrence of a failure of the dam concurrent with a Probable Maximum Flood. The peak flows past Pokegama Dam for these conditions are approximately 30,500 cfs and 32,400 cfs, respectively. The possibility is extremely remote that either of these conditions will occur.

Preparation of the maps does not reflect on the safety or integrity of Pokegama Dam. They have been prepared as part of a national program to prepare similar maps for all Federal Dams.

The attached maps provide a basis for evaluating existing evacuation plans for the affected area and development of any further plans which are needed. The Corps of Engineers recommends that such evaluations be made and any needed supplemental plans be developed. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers.

D-3. Use of Maps

The general procedure for use of the attached maps is as follows:

a. Determine the portion of your area of concern which would be affected by inundation or isolation.

b. Identify routes which would be used for movement of people from each part of the area to be evacuated.

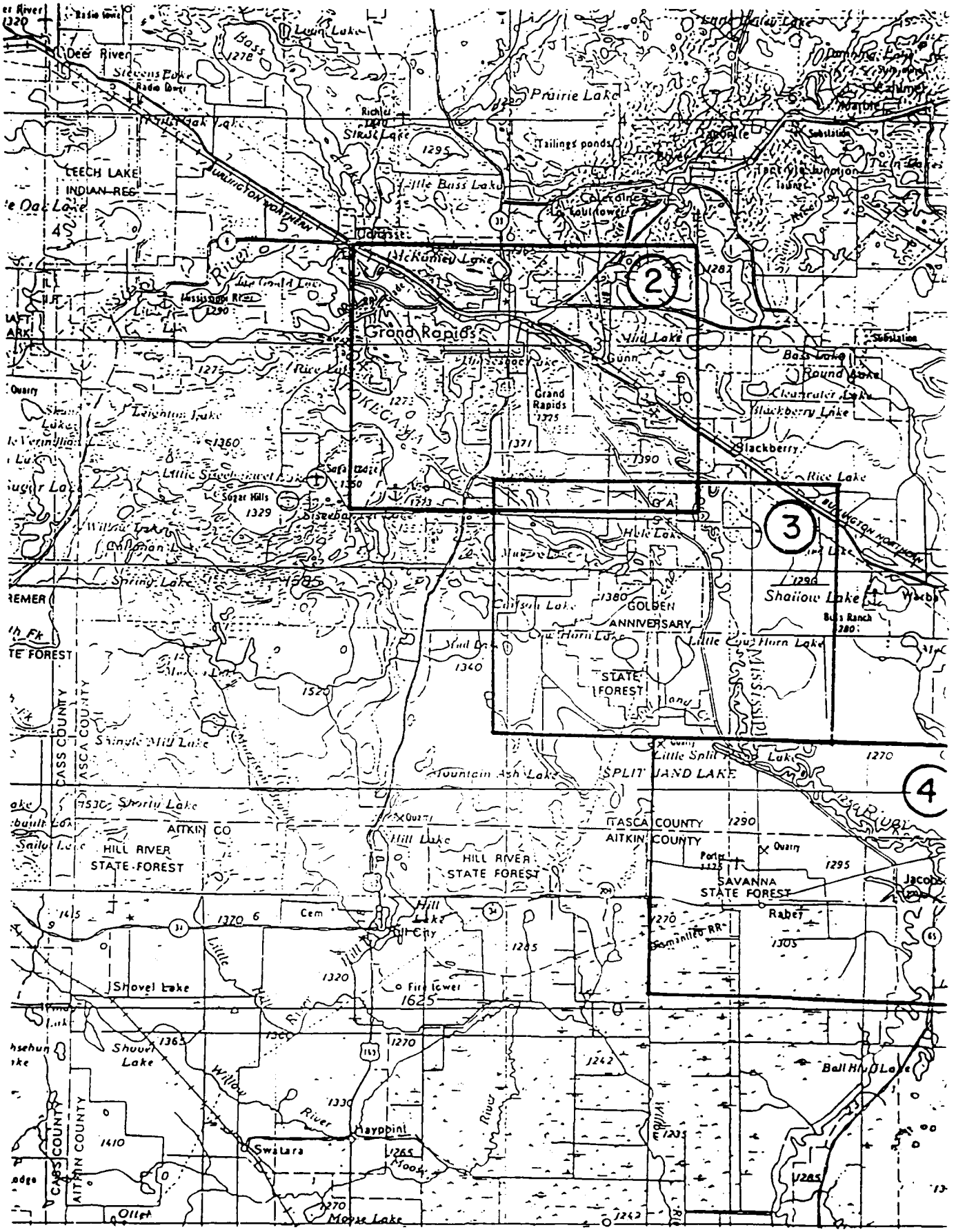
c. Identify the amount of time available for evacuation.

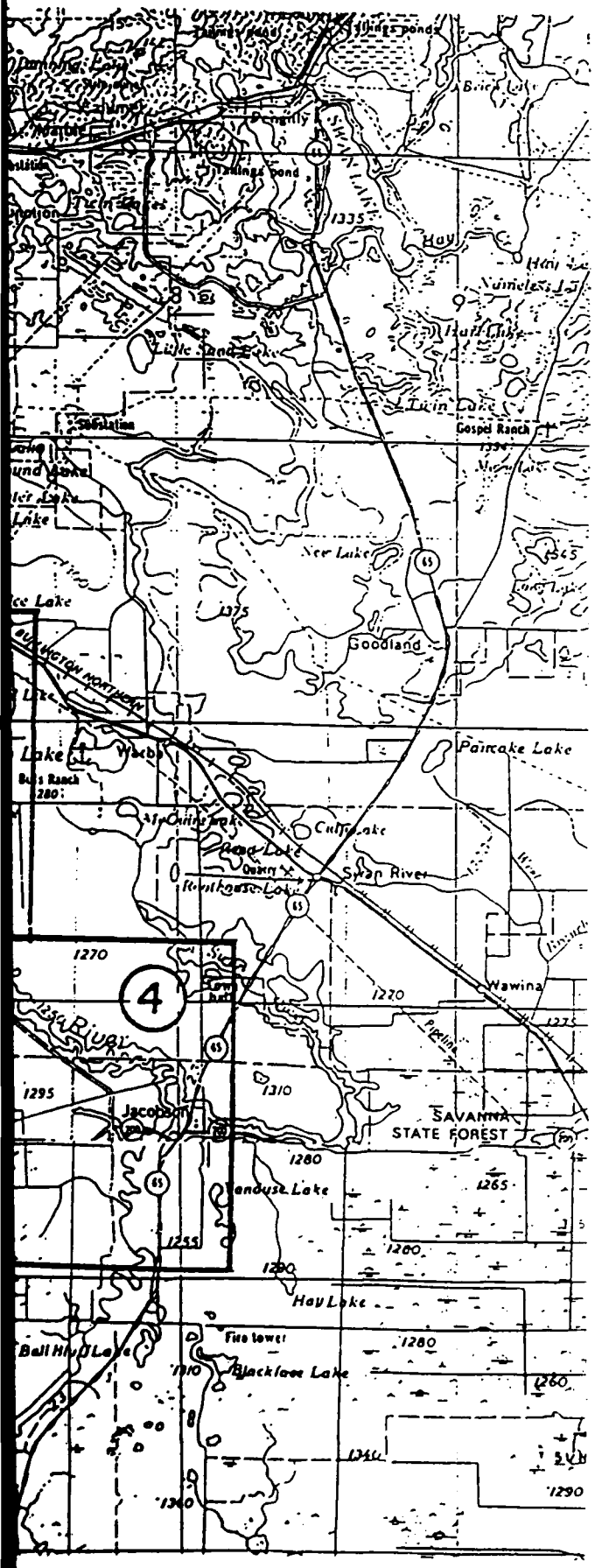
d. Use the information to assess whether existing evacuation plans cover all of the affected area and will provide for timely evacuation.

D-4. Definition of Terms

River mile	The distance along the channel of the Mississippi River from the Pokegama Dam.
Peak elevation	The comouted maximum water surface elevation which would be reached at a location due to assumed conditions.
Peak time	Elapsed time* after assumed event until peak elevation occurs.
NGVD	National Geodetic Vertical Datum (distance above mean sea level, 1929 adj.)
Probable Maximum Flood	The theoretical maximum flow that can be expected from the watershed.
Dam failure	Any condition resulting in the uncontrolled release of water other than over or through an uncontrolled spillway or outlet works.
Cross section	Point at which the shape of a stream channel or valley is measured, usually in a direction perpendicular to the direction of flow.
Arrival time	Arrival time of hazardous flows to a point, measured from the beginning of the storm.
Emergency	A condition in which the occurrence of a significant hazard to life or property is possible or certain to occur.

*Elapsed time for the case of Probable Maximum Flood without failure is measured from the time at which the reservoir level exceeds the top of the flood control pool. Elapsed time for the cases of Probable Maximum Flood with failure and failure at normal high pool level are measured from the beginning of failure.


Deer River
Bass Lake
Prairie Lake
Tailings ponds
LEECH LAKE INDIAN RES.
Little Bass Lake
McKinney Lake
Grand Rapids
Wild Lake
Gunn
Bass Lake
Round Lake
Clearwater Lake
Blackberry Lake
Blackberry
Rice Lake
Leighton Lake
Little Sugar Hills Lake
Sugar Hills
Diseberg Lake
Willow Lake
Spring Lake
Shallow Lake
GOLDEN ANNIVERSARY STATE FOREST
Little Cut Horn Lake
Shingle Mill Lake
Mountain Ash Lake
Little Split Lake
SPLIT HAND LAKE
Shorty Lake
HILL RIVER STATE FOREST
Hill Lake
Hill City
ITASCA COUNTY
AITKIN COUNTY
SAVANNA STATE FOREST
Rabet
Shovel Lake
Fire Tower
Willow River
Swatara
Hayppint
Moose Lake
Ball Hill Lake
CASS COUNTY
ASCA COUNTY
AITKIN CO
2
3
4



N

LEGEND

Inundation Map

Plate No. ◯

Locations of Map Panels

—— 12 Cross Section

5 0 5

SCALE IN MILES

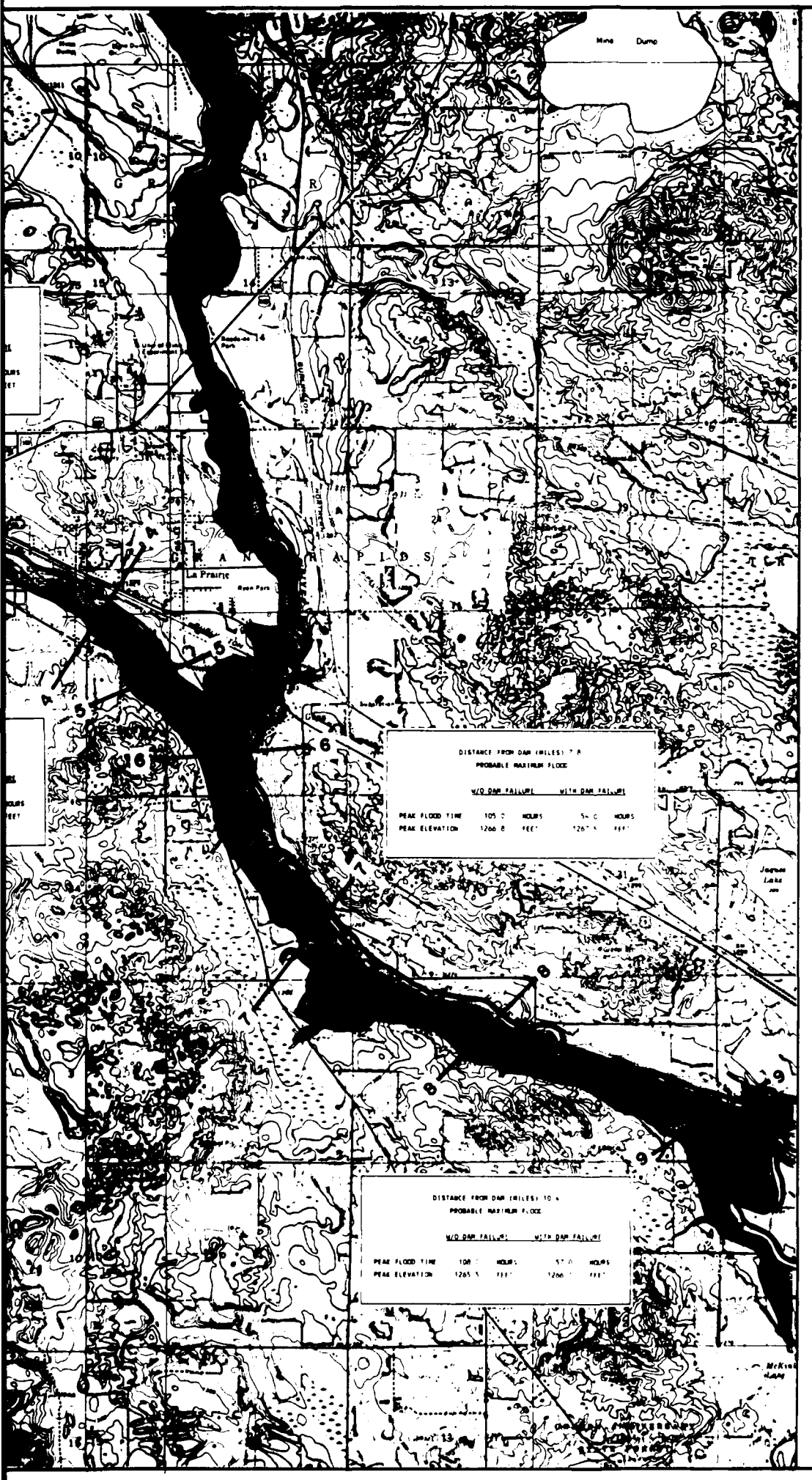
U. S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

POKEGAMA DAM EMERGENCY PLAN

INDEX MAP

PLATE D-1


DISTANCE FROM DAM (MILES) 0.1
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 96.0 HOURS 48.0 HOURS
PEAK ELEVATION 1280.0 FEET 1280.4 FEET
DISTANCE FROM DAM (MILES) 3.7
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 102.0 HOURS 51.0 HOURS
PEAK ELEVATION 1274.6 FEET 1275.7 FEET
DISTANCE FROM DAM (MILES) 1.7
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 102.0 HOURS 51.0 HOURS
PEAK ELEVATION 1279.7 FEET 1280.1 FEET
DISTANCE FROM DAM (MILES) 6.9
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 102.0 HOURS 54.0 HOURS
PEAK ELEVATION 1274.6 FEET 1275.5 FEET
McKinney Lake
Hale Lake
Forest Lake
Lily Lake



N

LEGEND

Limit of Spillway Design Flood without Dam Failure

Limit of Spillway Design Flood with Dam Failure

32 — 32 Cross Section

Corporate Limits

2000 0 2000 4000 6000

SCALE IN FEET

Contour interval 10 feet

National Geodetic vertical datum of 1929

Source of base map: U.S. Geological Survey 7.5 minute series: Cohasset East, Bovey, Grand Rapids, La Prairie, 1969

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Pokegama Dam

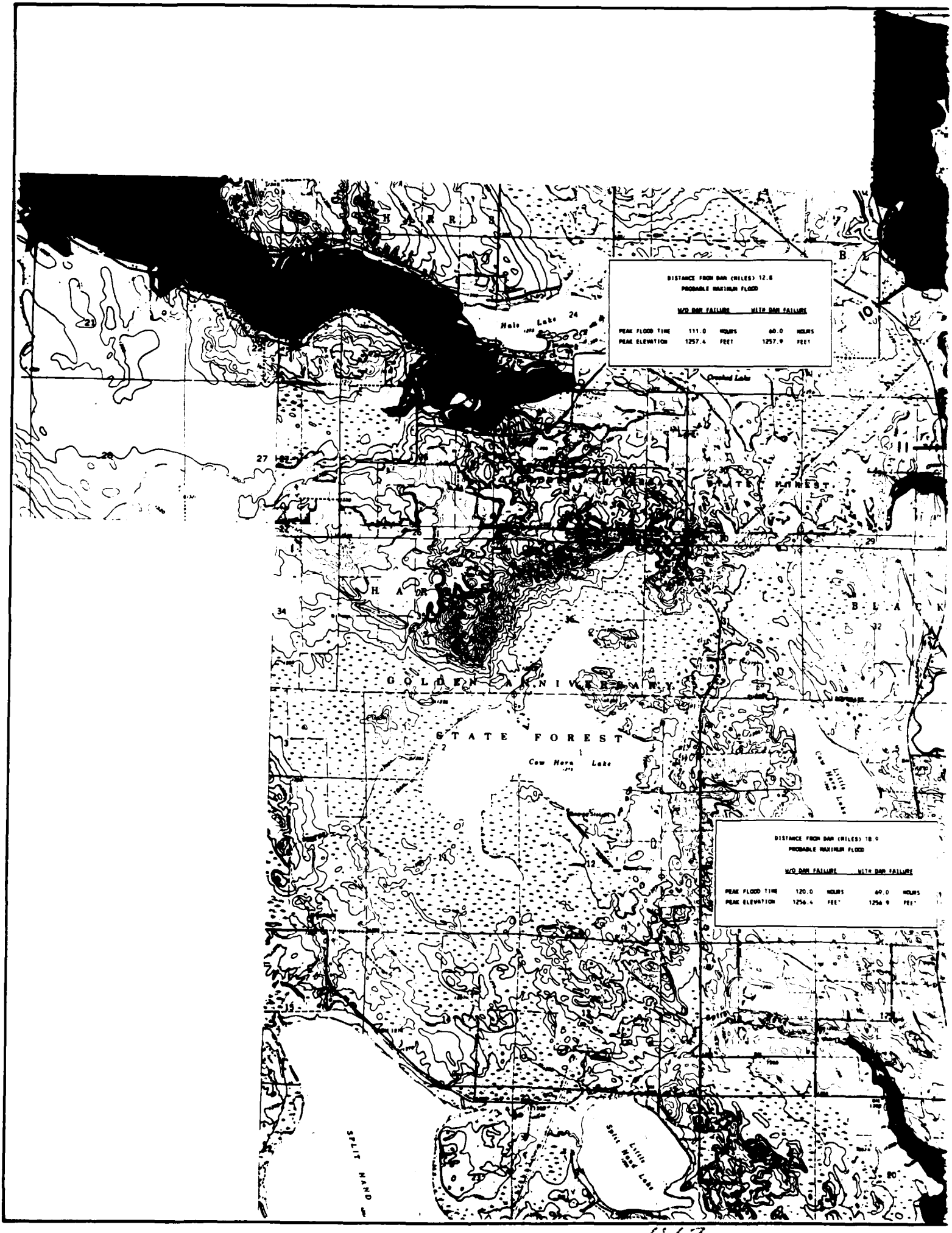
U.S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

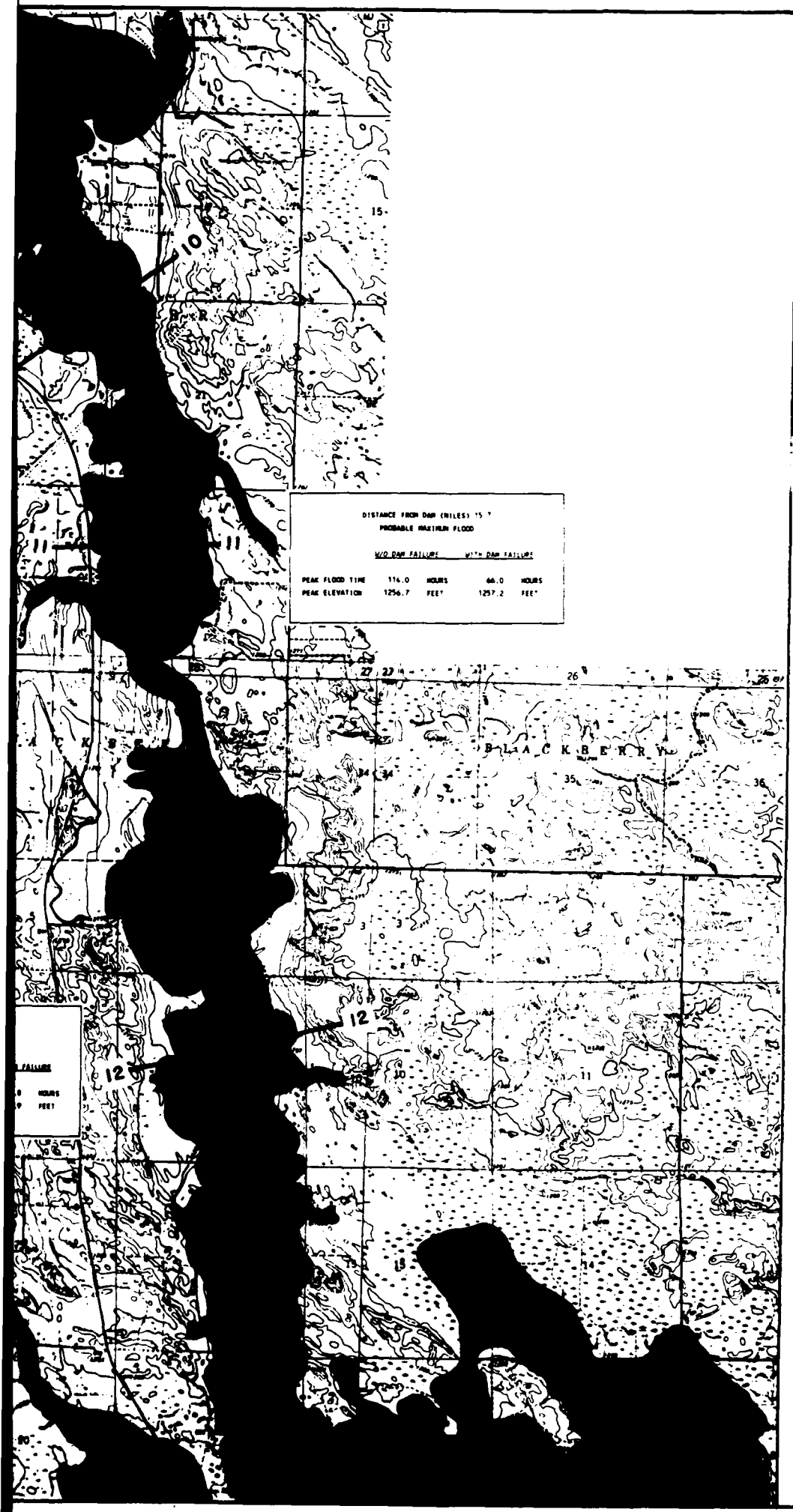
POKEGAMA DAM
EMERGENCY PLAN

INUNDATION MAP

MARCH 1987

PLATE NO. D-2


DISTANCE FROM DAM (MILES) 12.6
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE
WITH DAM FAILURE
PEAK FLOOD TIME 111.0 HOURS 60.0 HOURS
PEAK ELEVATION 1257.4 FEET 1257.9 FEET
DISTANCE FROM DAM (MILES) 18.0
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE
WITH DAM FAILURE
PEAK FLOOD TIME 120.0 HOURS 69.0 HOURS
PEAK ELEVATION 1256.4 FEET 1256.9 FEET
Hole Lake
Crooked Lake
Cow Horn Lake
STATE FOREST
SPLIT HAND



LEGEND

Limit of Spillway Design Flood without Dam Failure

Limit of Spillway Design Flood With Dam Failure

32 — 32 Cross Section

Corporate Limits

2000 0 2000 4000 6000

SCALE IN FEET

Contour interval 10 feet

National Geodetic vertical datum of 1929

Source of base map U S Geological Survey 7.5 minute series, Grand Rapids, LaPrairie, 1969
Split Hand Lake, Jacobson, 1970

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Pokegama Dam.

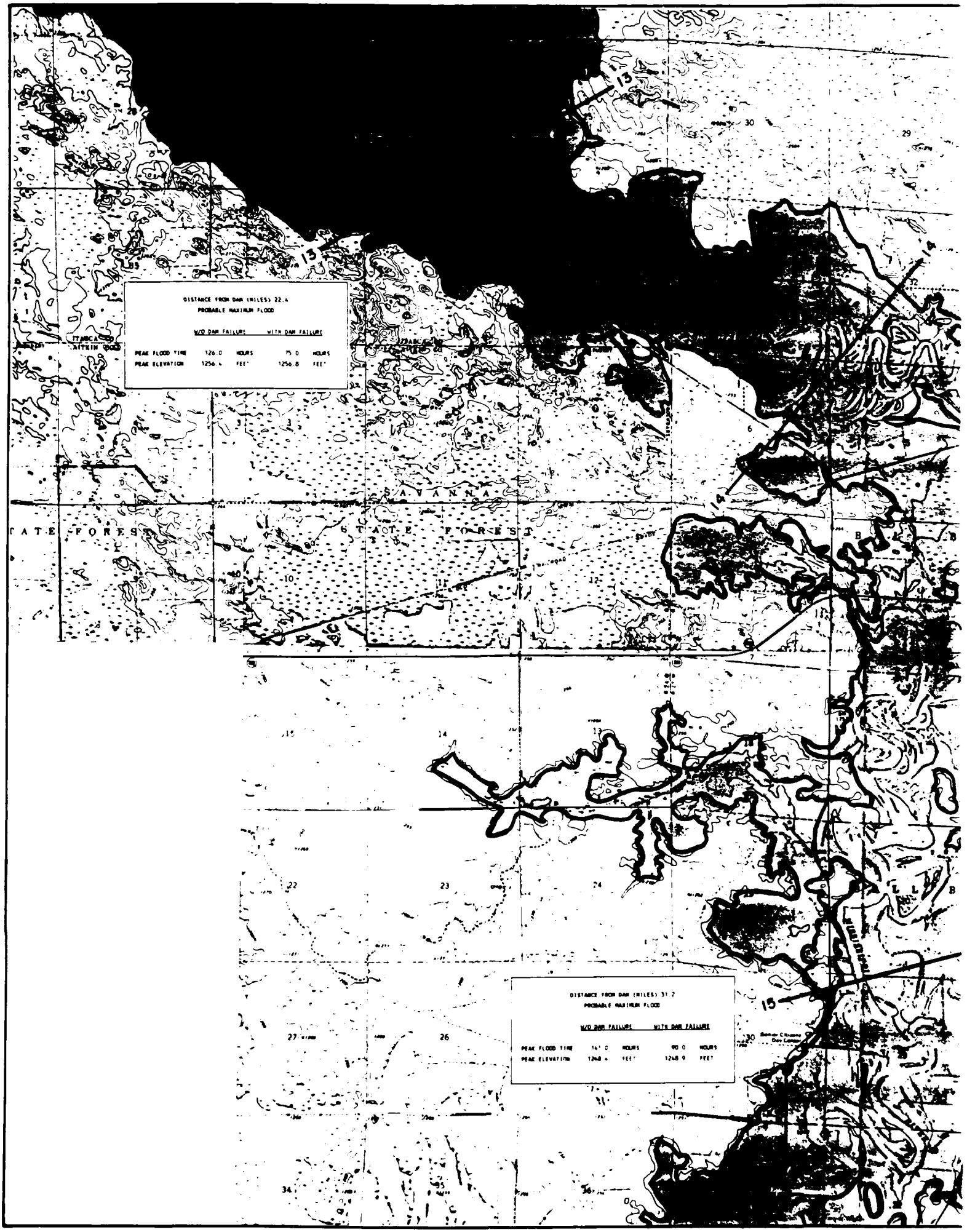
U S ARMY ENGINEER DISTRICT, ST PAUL
CORPS OF ENGINEERS
ST PAUL, MINNESOTA

POKEGAMA DAM EMERGENCY PLAN

INUNDATION MAP

MARCH 1987

PLATE NO D-3


DISTANCE FROM DAM (MILES) 22.4
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 126.0 HOURS 75.0 HOURS
PEAK ELEVATION 1256.4 FEET 1256.8 FEET
ITASCA AND ATTEIN QUAD
ITASCA STATE PARK
S A V A N N A
S T A T E F O R E S T
DISTANCE FROM DAM (MILES) 31.2
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 141.0 HOURS 90.0 HOURS
PEAK ELEVATION 1248.4 FEET 1248.9 FEET

LEGEND

Limit of Spillway Design Flood Without Dam Failure

Limit of Spillway Design Flood With Dam Failure

32 — 32 Cross Section

Corporate Limits

2000 0 2000 4000 6000

SCALE IN FEET

Contour interval 10 feet

National Geodetic vertical datum of 1929

Source of base map: U S Geological Survey 7.5 minute series, Split Hand Lake, Jacobson, Bell Bluff, 1970

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Pokegama Dam.

U S ARMY ENGINEER DISTRICT, ST PAUL
CORPS OF ENGINEERS
ST PAUL, MINNESOTA

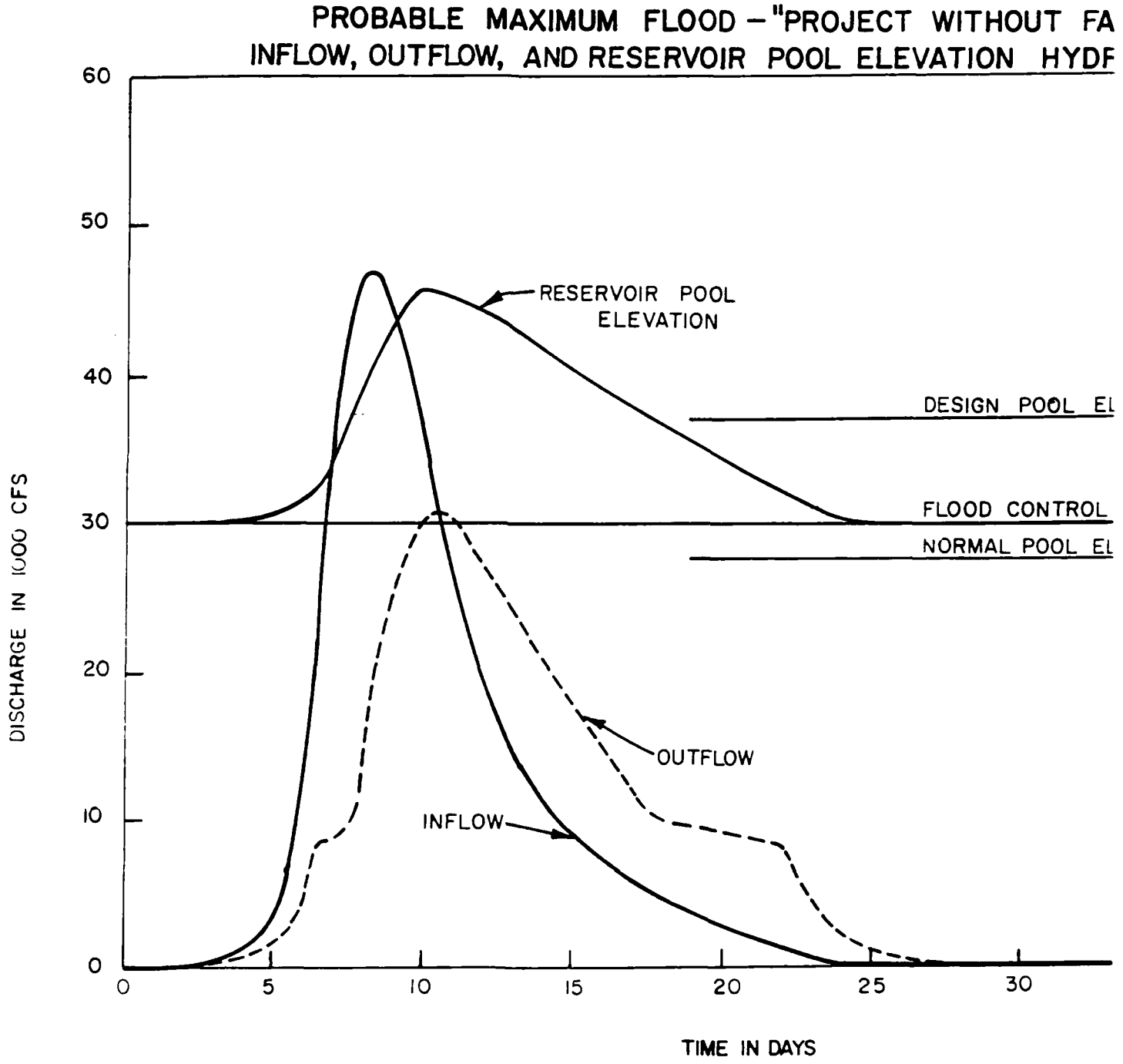
POKEGAMA DAM
EMERGENCY PLAN

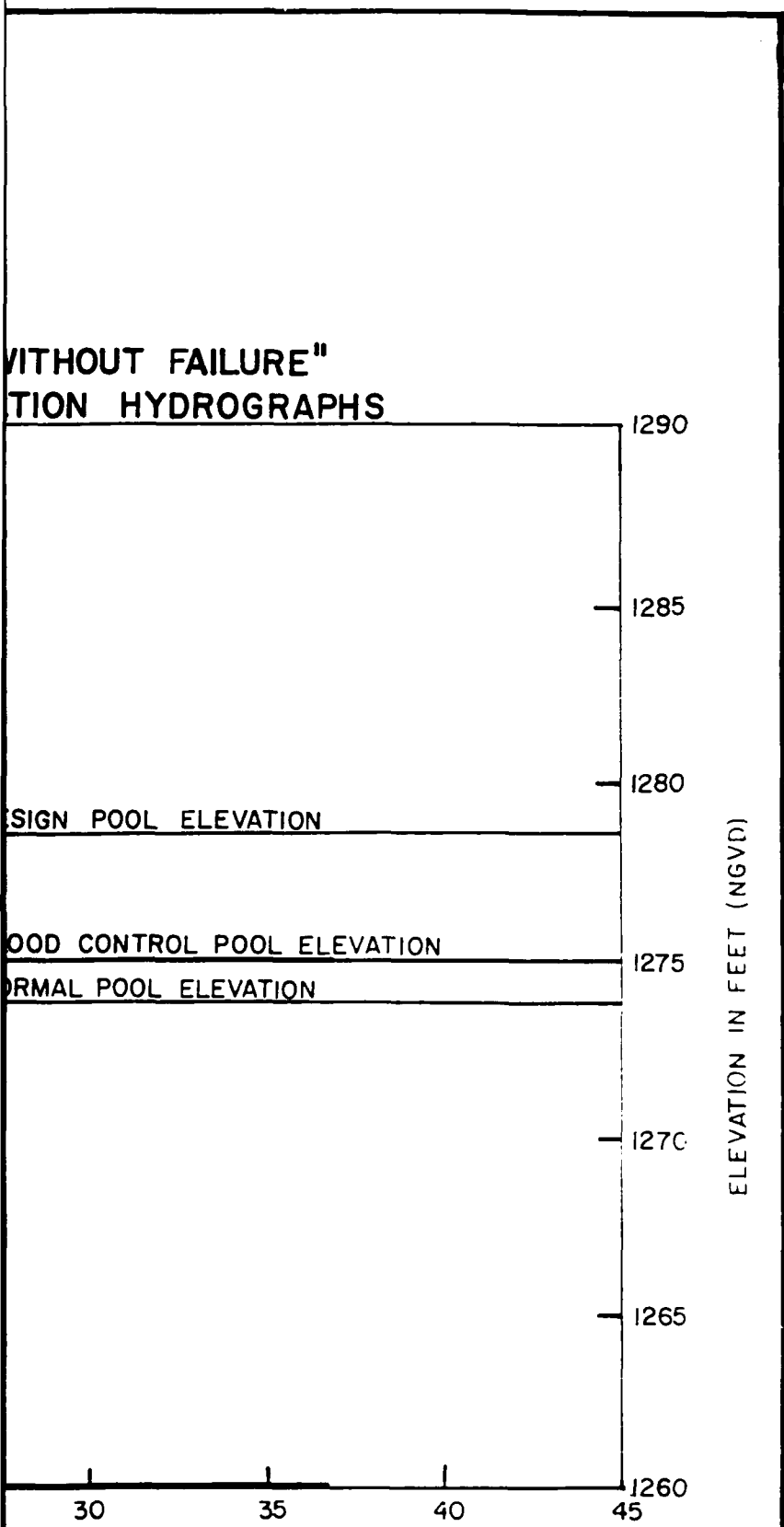
INUNDATION MAP

MARCH 1987

PLATE NO D-4

12


PROBABLE MAXIMUM FLOOD – "PROJECT WITHOUT FA
INFLOW, OUTFLOW, AND RESERVOIR POOL ELEVATION HYDF
60
50
40
30
20
10
0
DISCHARGE IN 1000 CFS
RESERVOIR POOL ELEVATION
DESIGN POOL EL
FLOOD CONTROL
NORMAL POOL EL
OUTFLOW
INFLOW
0
5
10
15
20
25
30
TIME IN DAYS

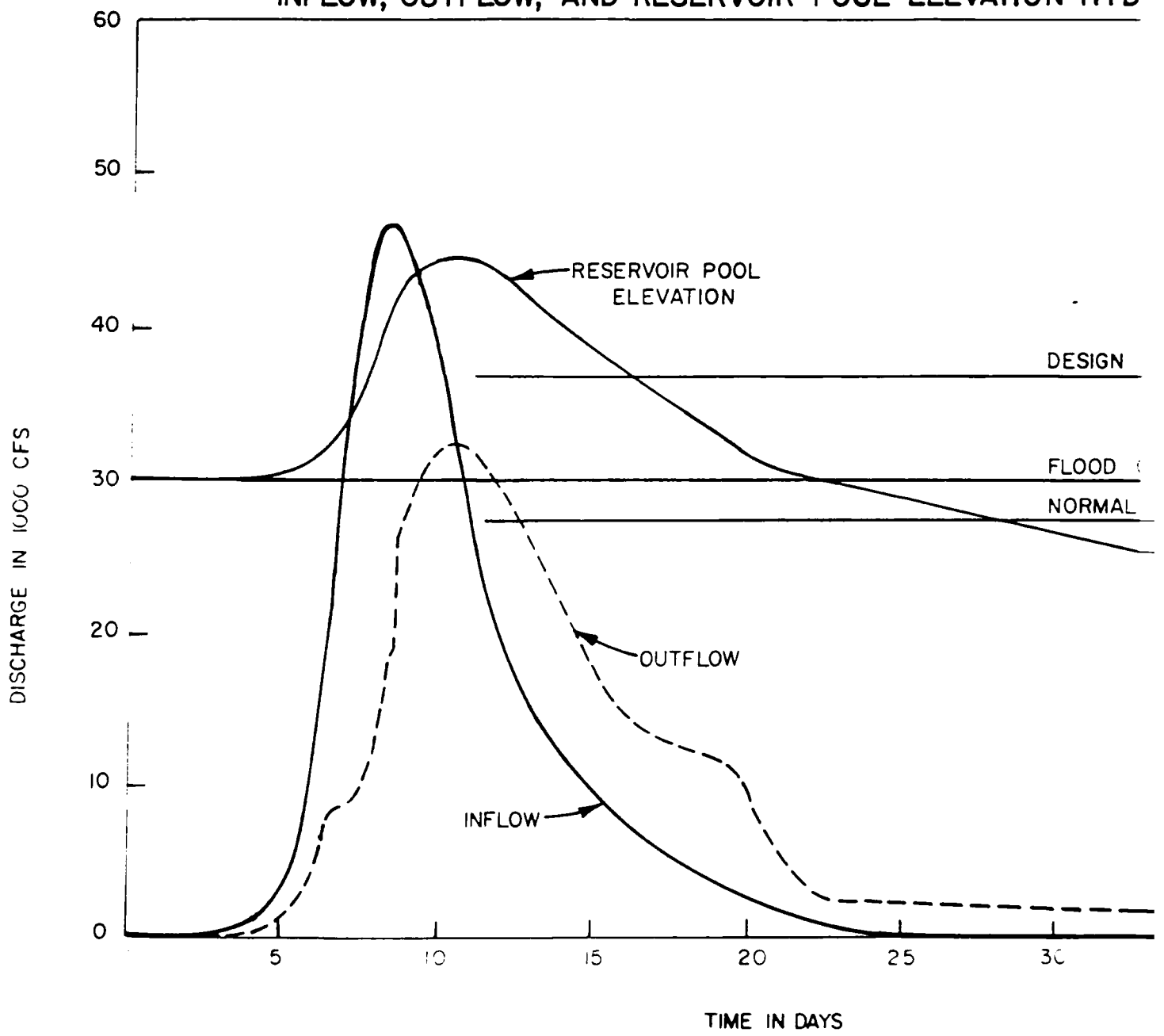


U.S. ARMY ENGINEER DISTRICT, ST PAUL
CORPS OF ENGINEERS
ST PAUL, MINNESOTA

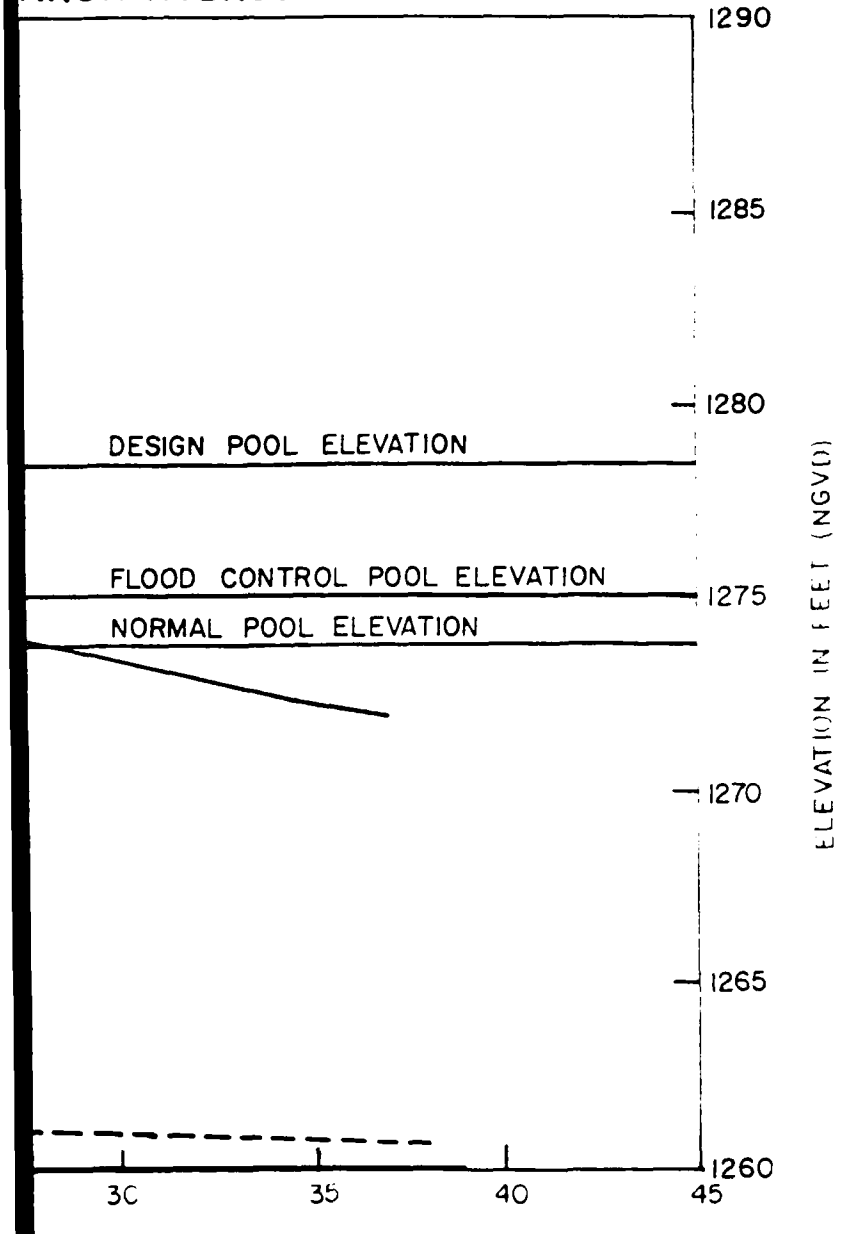
EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

PLATE D-6

PROBABLE MAXIMUM FLOOD – "PROJECT WITH FAILUI
INFLOW, OUTFLOW, AND RESERVOIR POOL ELEVATION HYD



VITH FAILURE"
ATION HYDROGRAPHS



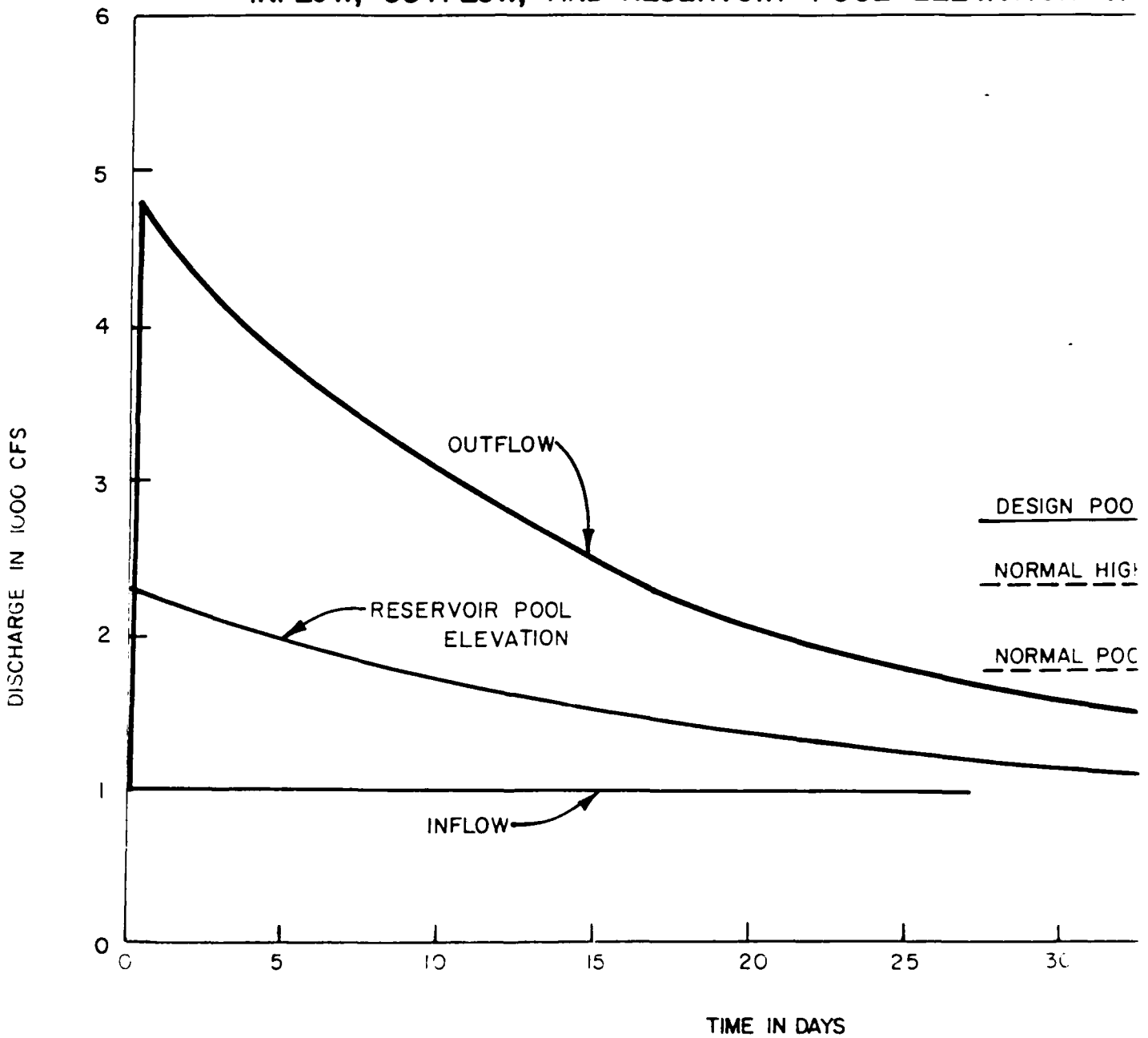
U S ARMY ENGINEER DISTRICT, ST PAUL
CORPS OF ENGINEERS
ST PAUL, MINNESOTA

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

9/82

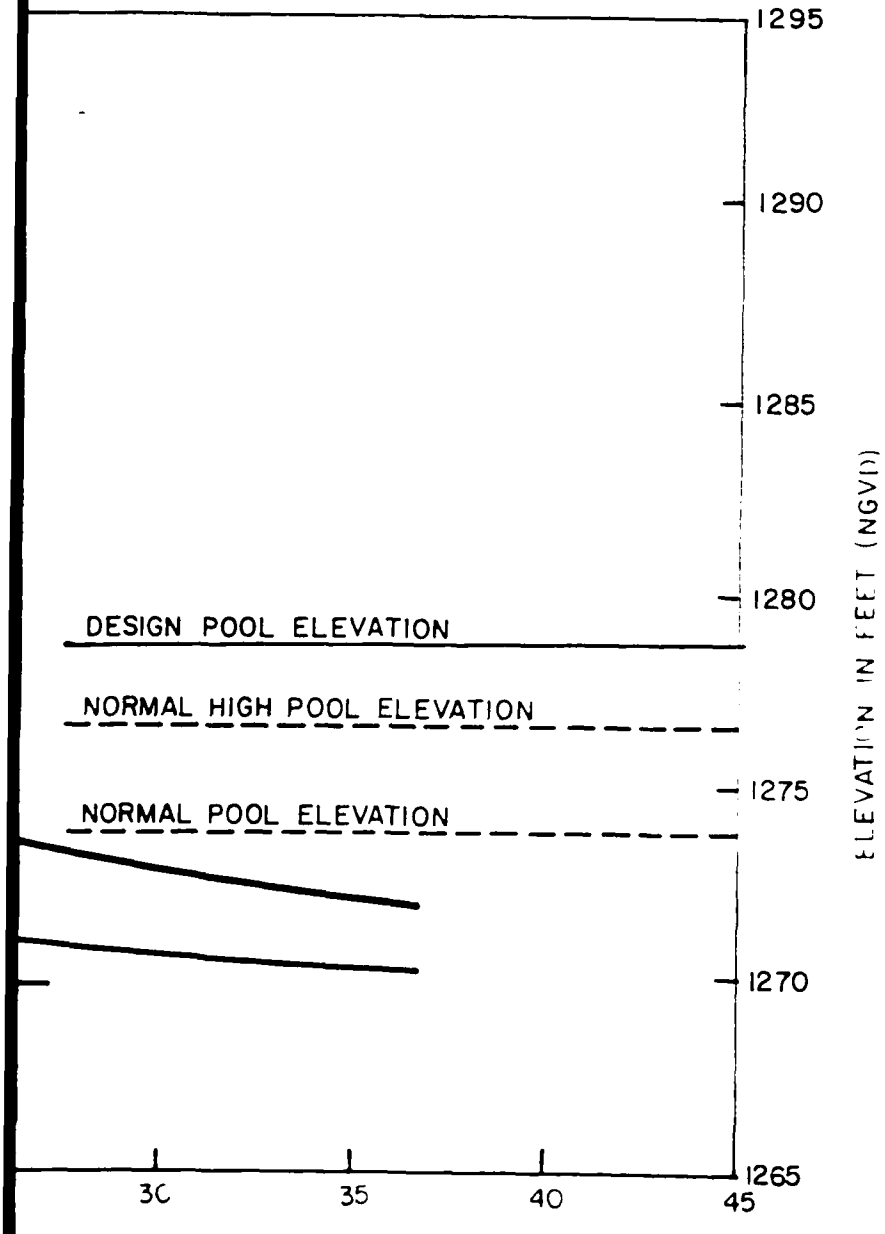
PLATE D-6

"FAILURE AT NORMAL HIGH POOL ELEVATION"
INFLOW, OUTFLOW, AND RESERVOIR POOL ELEVATION H



1942

ELEVATION"
EVATION HYDROGRAPHS



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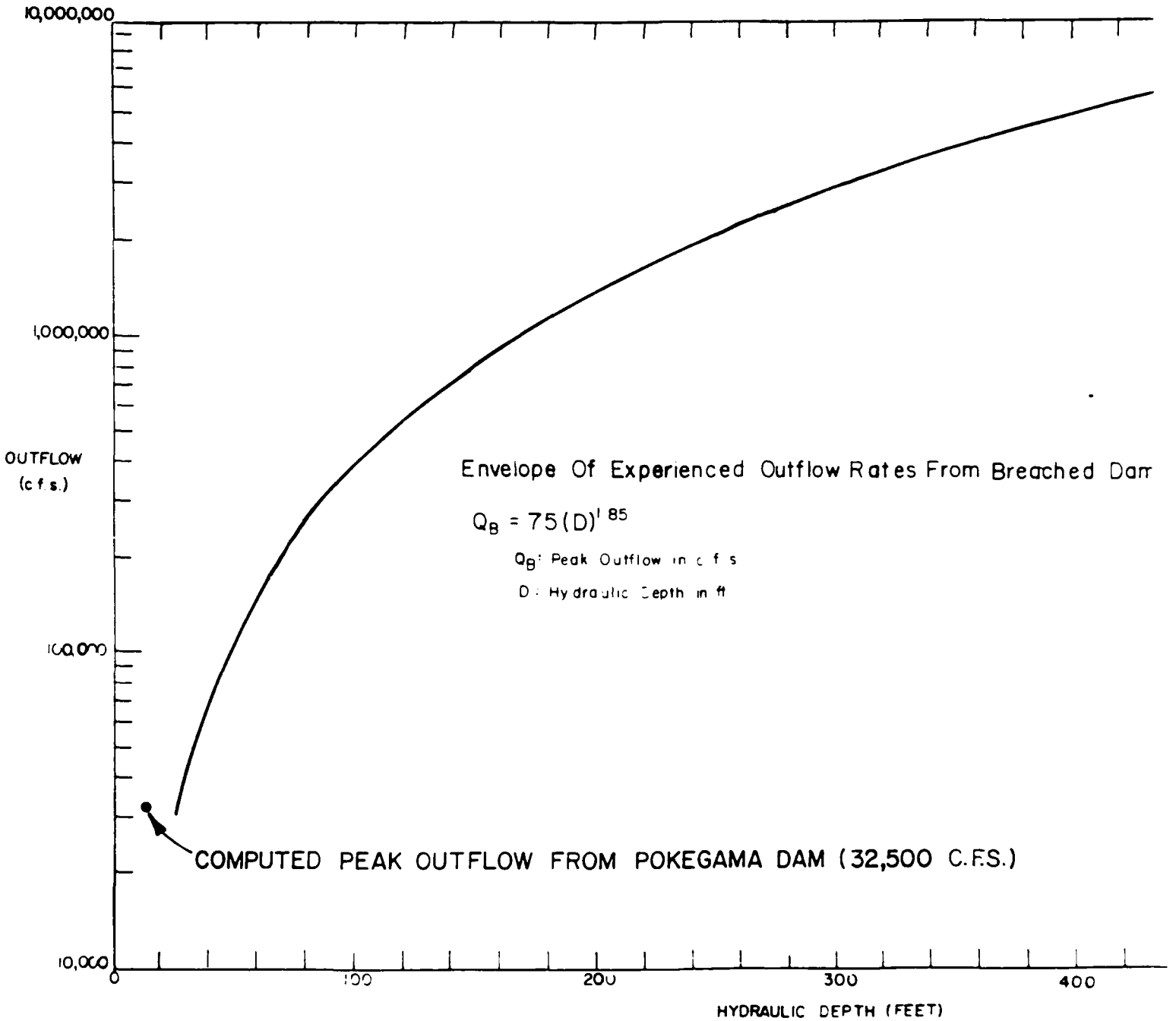
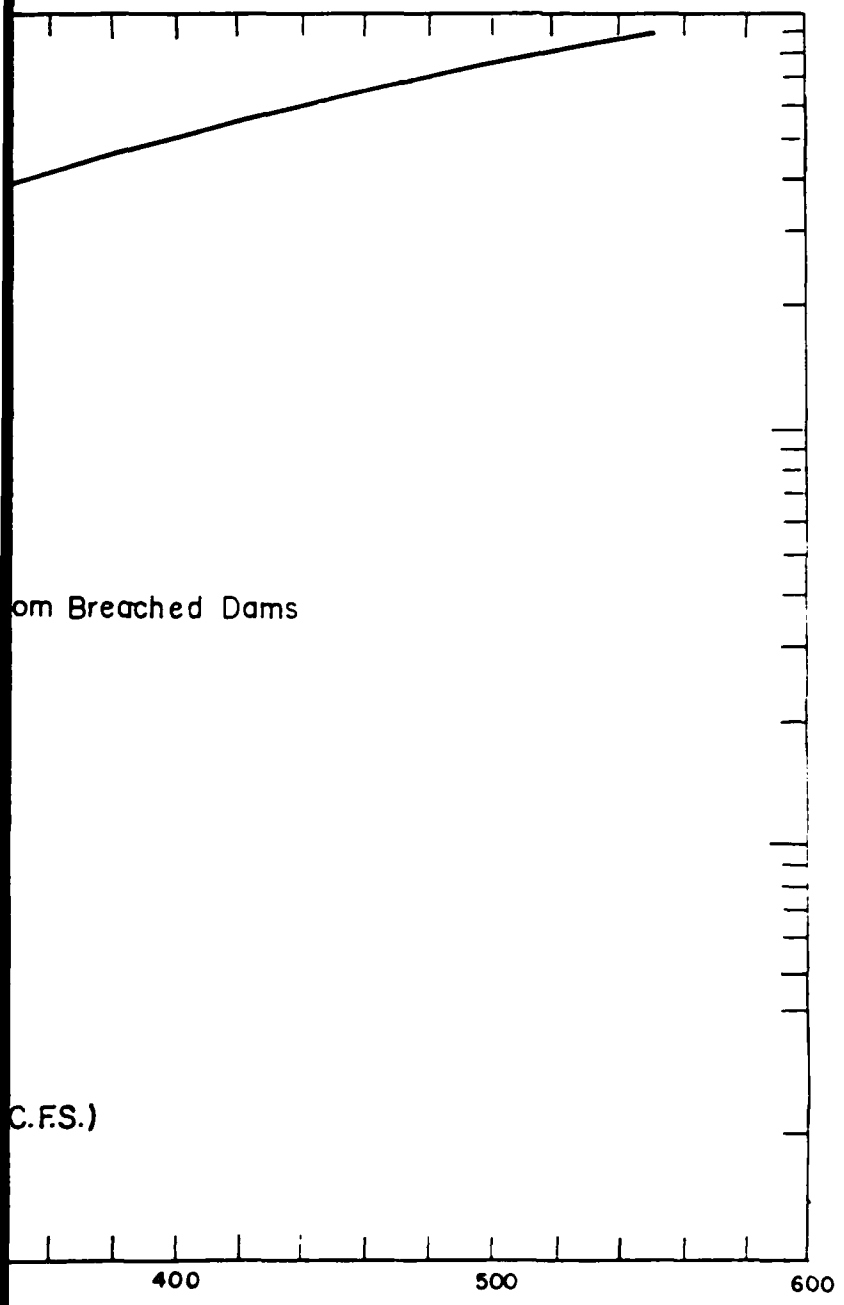
ST PAUL, MINNESOTA

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

PLATE D-7


10,000,000
1,000,000
100,000
10,000
OUTFLOW
(c.f.s.)
Envelope Of Experienced Outflow Rates From Breached Dam
$Q_B = 75(D)^{1.85}$
Q_B: Peak Outflow in c.f.s
D: Hydraulic Depth in ft
COMPUTED PEAK OUTFLOW FROM POKEGAMA DAM (32,500 C.F.S.)
0
100
200
300
400
HYDRAULIC DEPTH (FEET)



U S ARMY ENGINEER DISTRICT, ST PAUL
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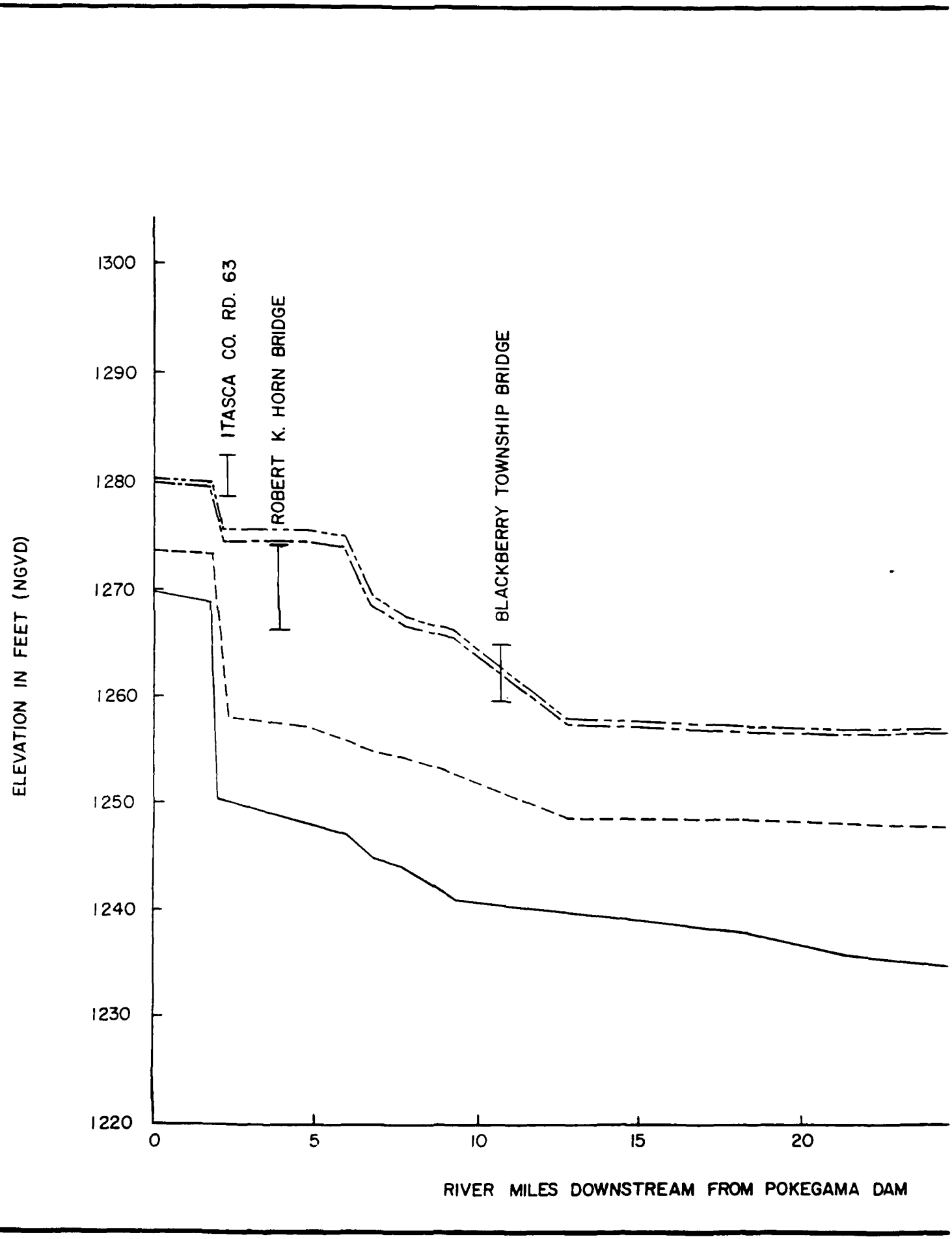
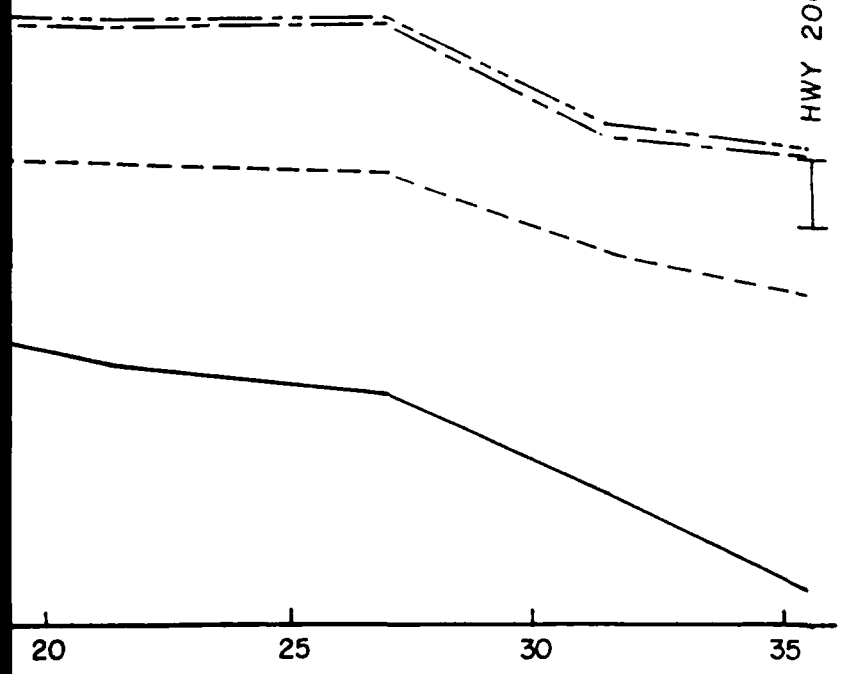
ST PAUL, MINNESOTA

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

COMPARISON
OF
COMPUTED OUTFLOW RATES

PLATE D-8


ELEVATION IN FEET (NGVD)
1300
1290
1280
1270
1260
1250
1240
1230
1220
ITASCA CO. RD. 63
ROBERT K. HORN BRIDGE
BLACKBERRY TOWNSHIP BRIDGE
0
5
10
15
20
RIVER MILES DOWNSTREAM FROM POKEGAMA DAM



LEGEND

- Probable Maximum Flood With Failure
- Probable Maximum Flood
- Failure at Normal High Pool Elevation
- Low Bank Elevation

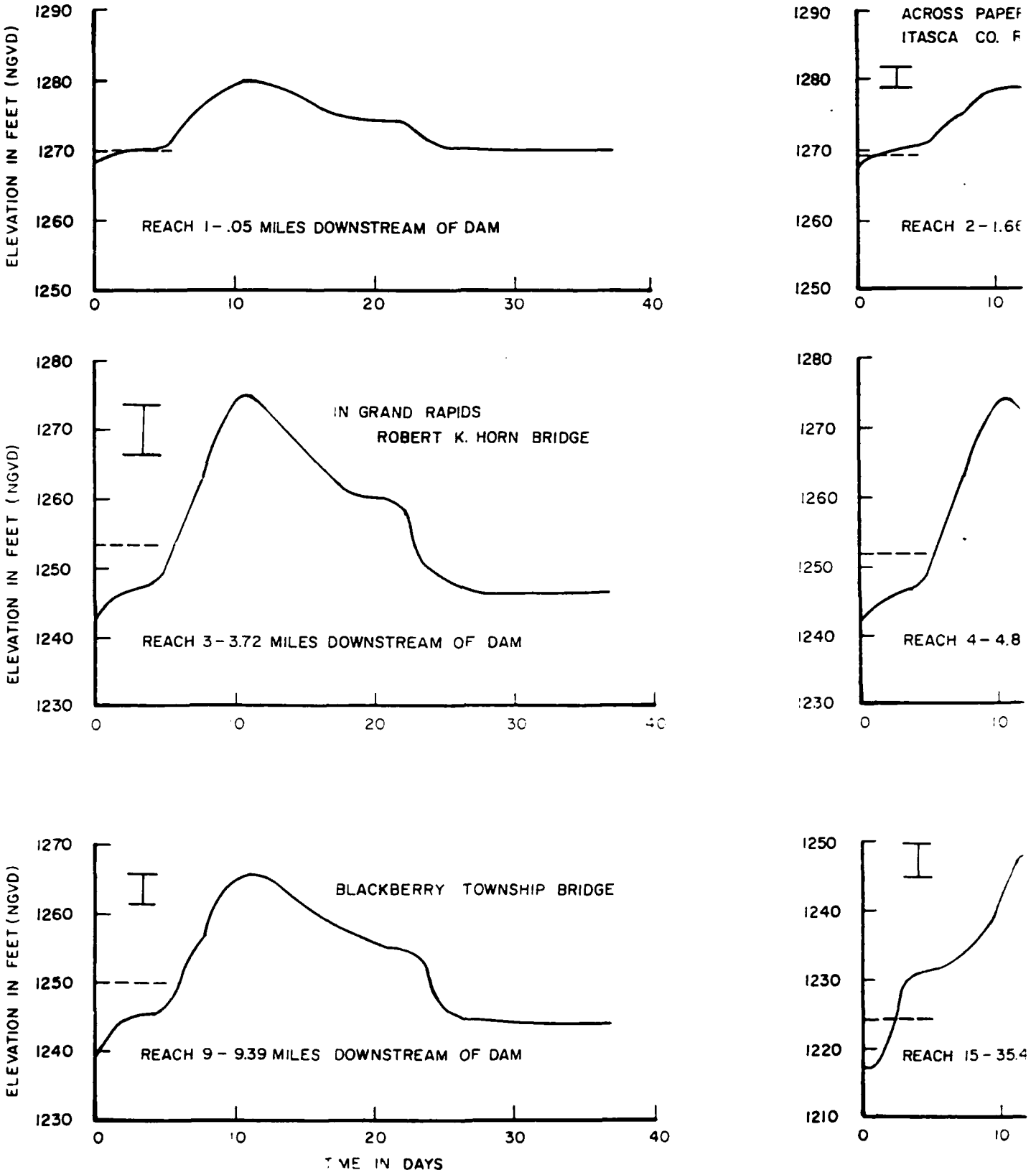
- Top of Roadbed or Wo
- Bridge Elevation
- Low Chord or Top of Arch

U S ARMY ENGINEER DISTRICT, ST PAUL
CORPS OF ENGINEERS
ST PAUL, MINNESOTA

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

CREST PROFILES

PLATE NO D-9

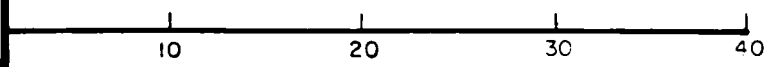


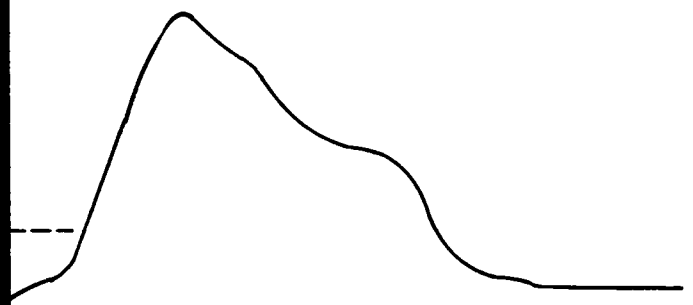
NOTE: TIME ZERO IS AT BEGINNING OF STORM.

142

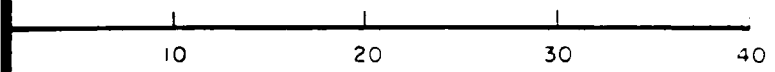
ACROSS PAPER MILL RESERVOIR
ITASCA CO. RD. 63

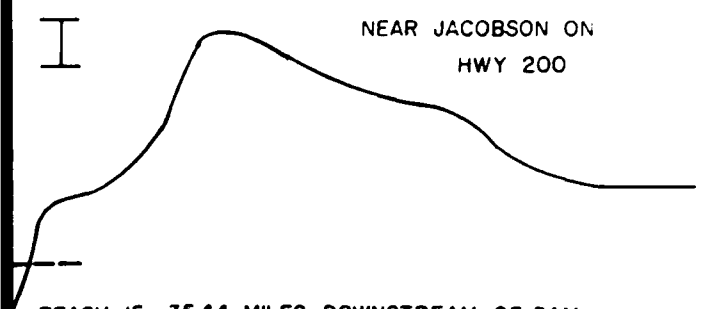
REACH 2 - 1.66 MILES DOWNSTREAM OF DAM



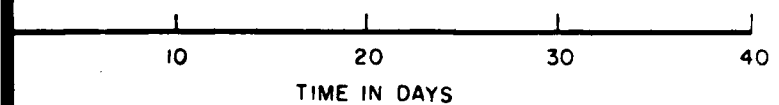


REACH 4 - 4.88 MILES DOWNSTREAM OF DAM

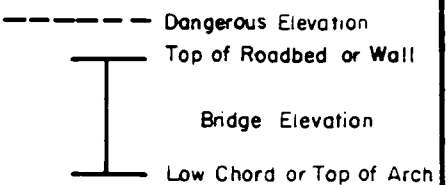




REACH 15 - 35.44 MILES DOWNSTREAM OF DAM



LEGEND



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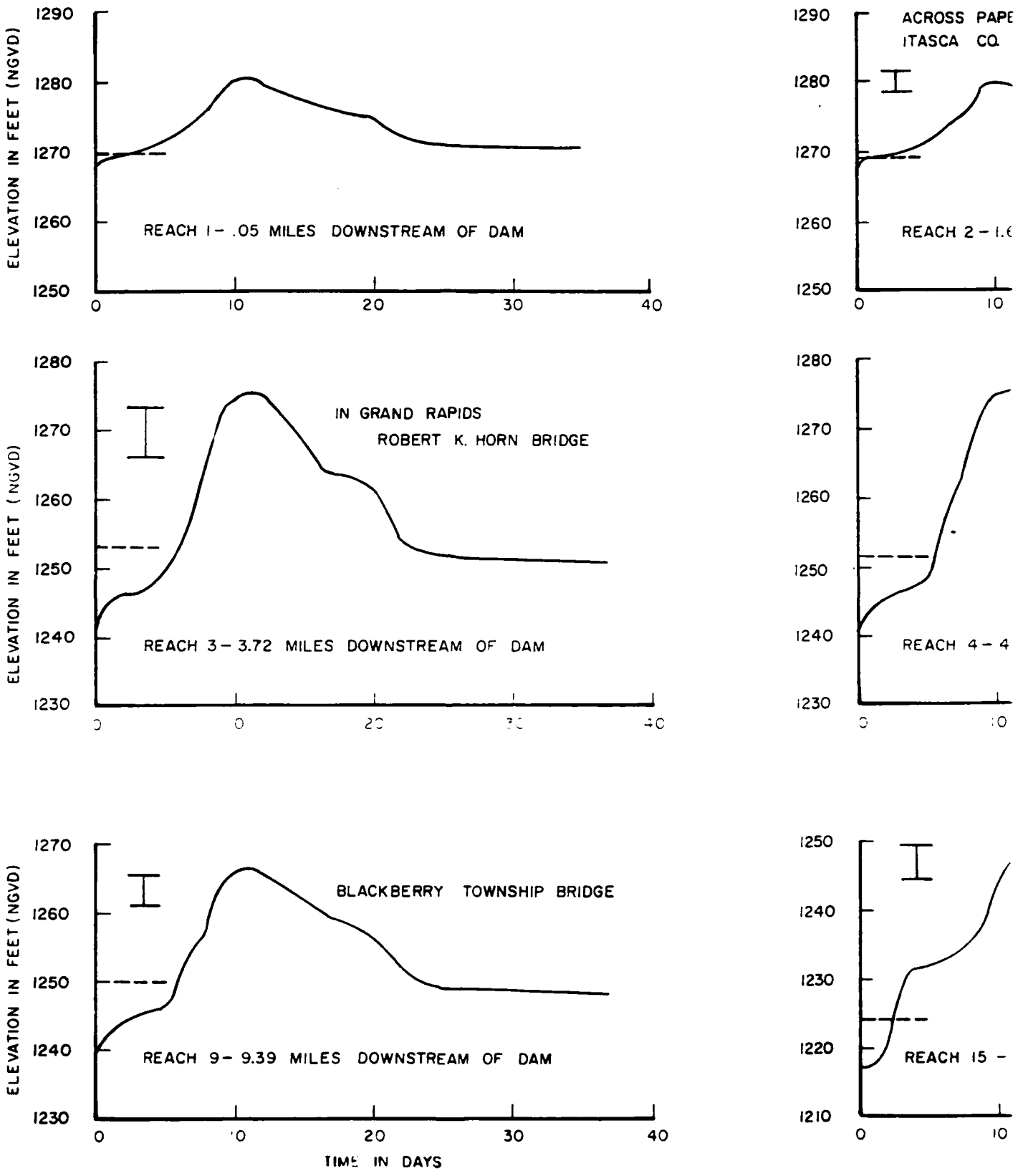
ST. PAUL, MINNESOTA

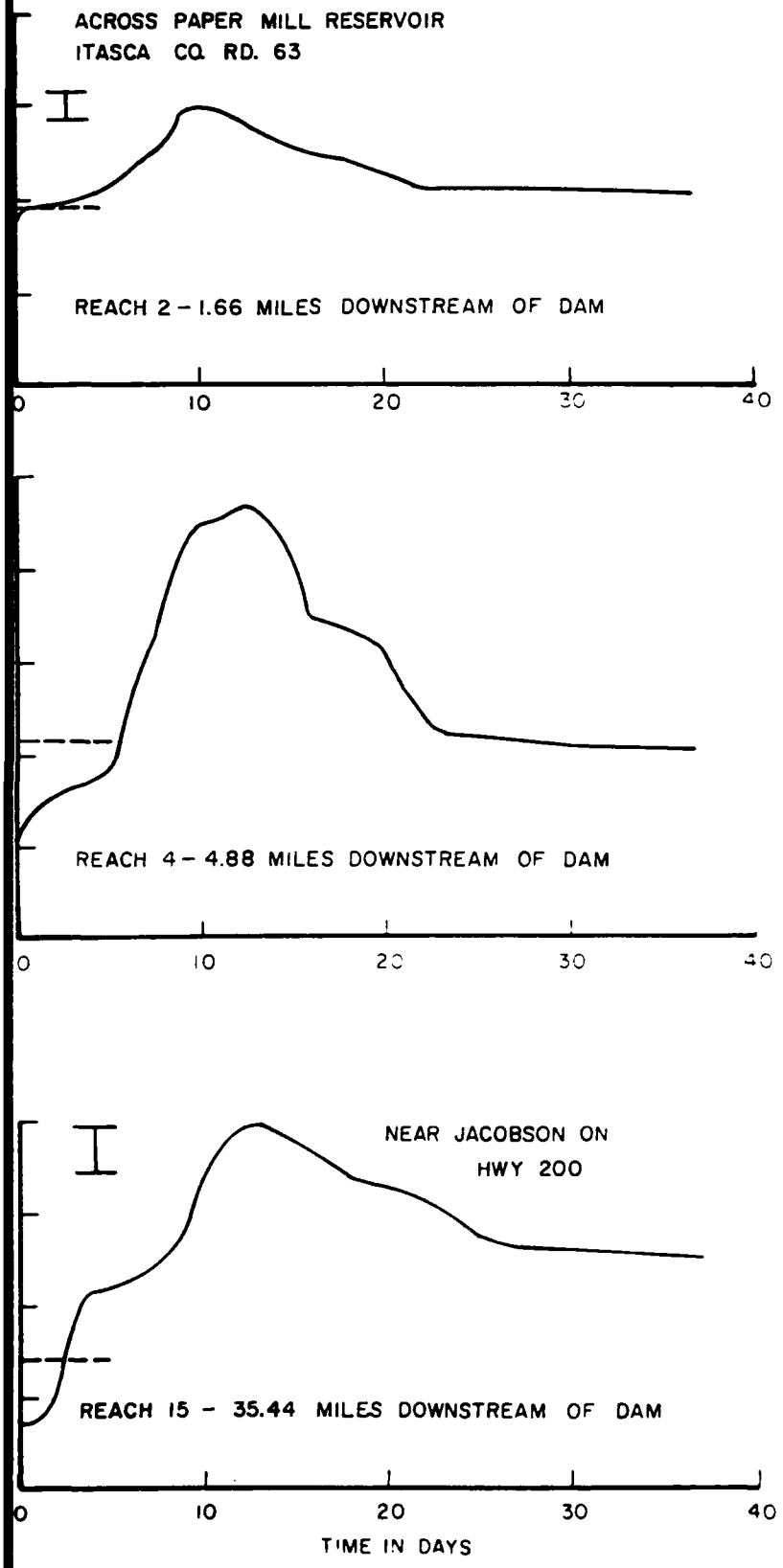
EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

STAGE HYDROGRAPH
FOR PROBABLE MAXIMUM
FLOOD WITHOUT FAILURE

PLATE D-10



NOTE: TIME ZERO IS AT BEGINNING OF STORM



LEGEND

Dangerous Elevation

Top of Roadbed or Wall

Bridge Elevation

Low Chord or Top of Arch

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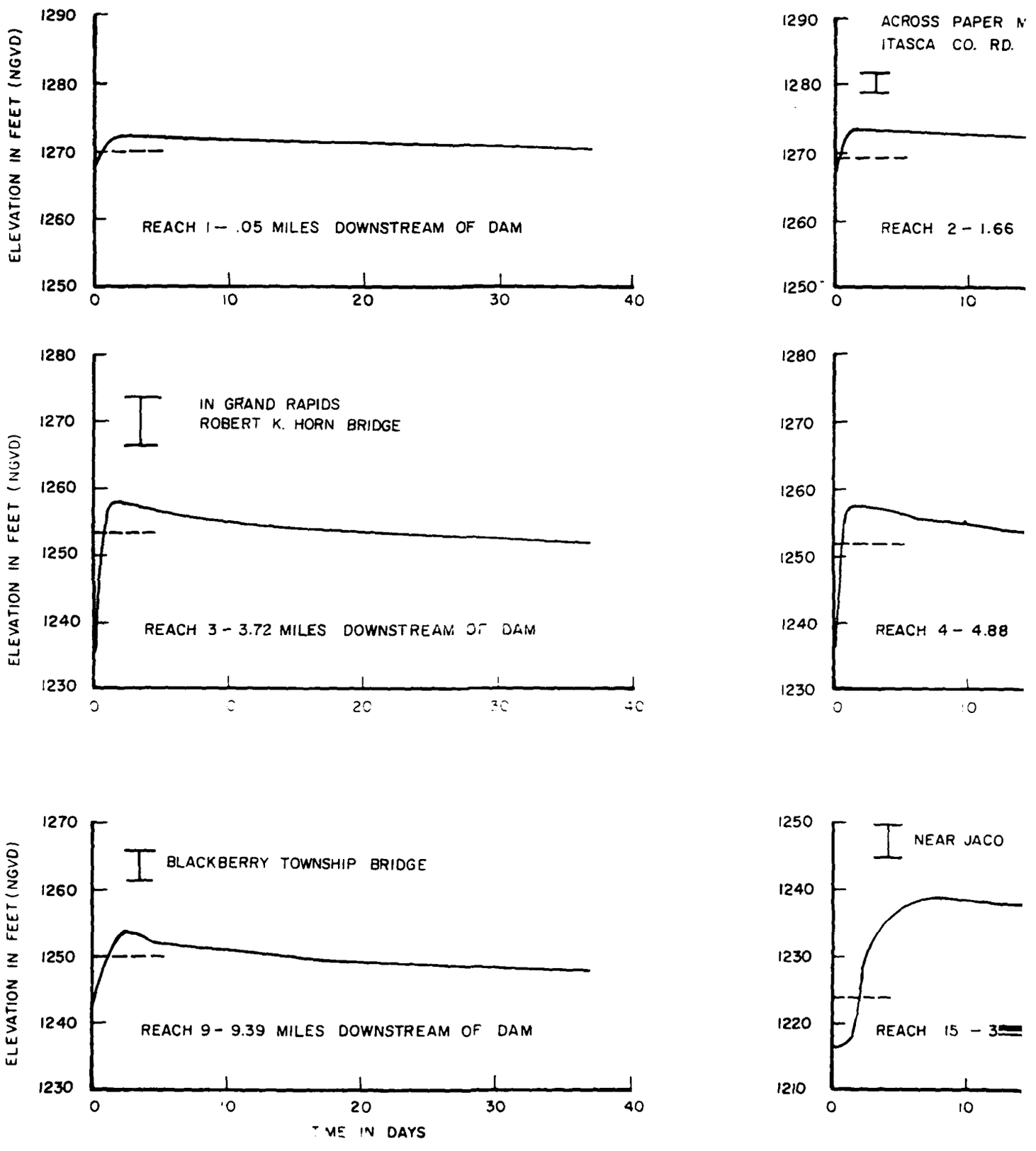
ST. PAUL, MINNESOTA

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

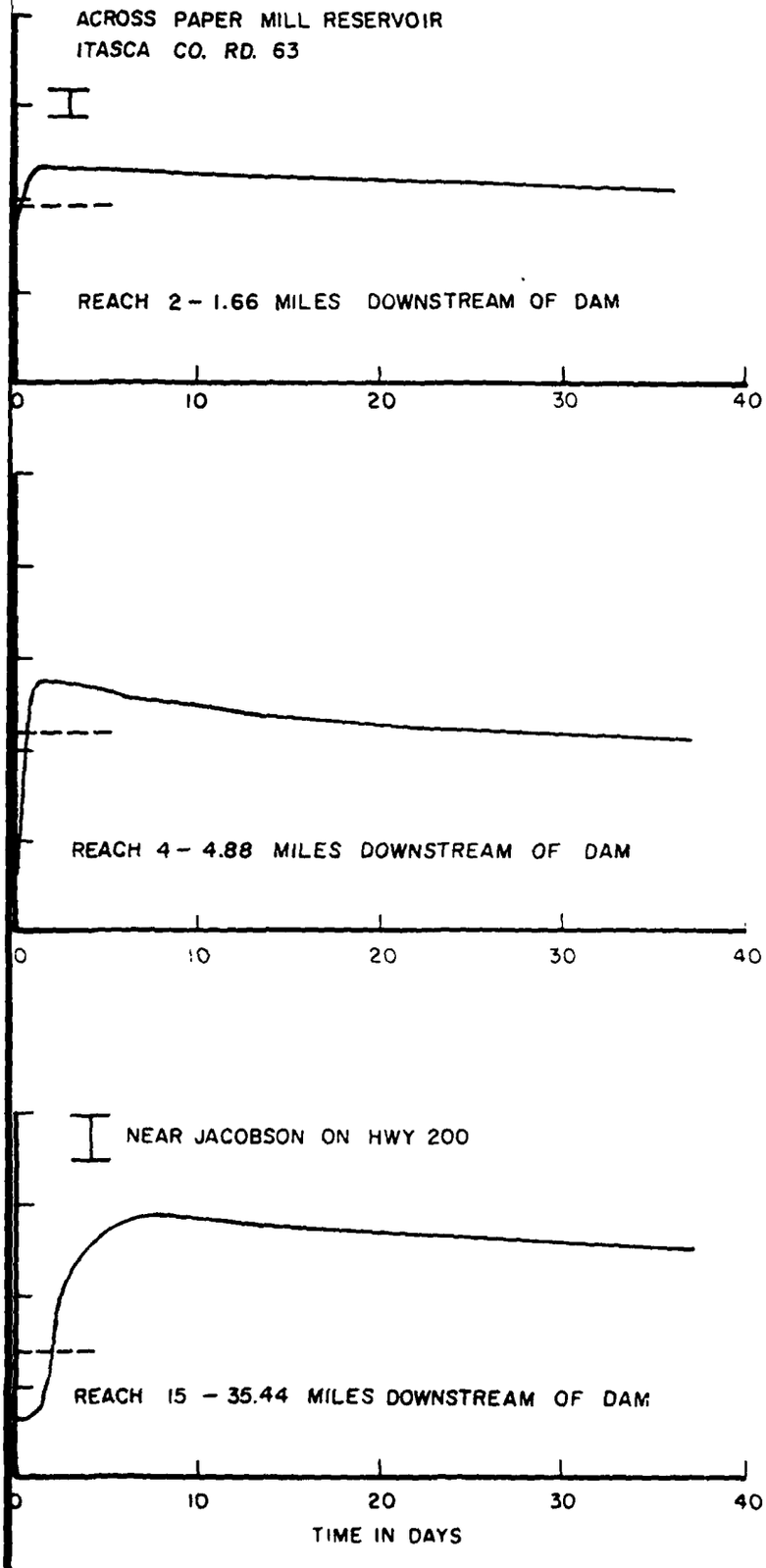
STAGE HYDROGRAPH
FOR PROBABLE MAXIMUM
FLOOD WITH FAILURE

PLATE D-11

2163



NOTE: TIME ZERO IS AT BEGINNING OF STORM



LEGEND

Dangerous Elevation

Top of Roadbed or Wall

Bridge Elevation

Low Chord or Top of Arch

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CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

EMERGENCY PLAN
POKEGAMA DAM
AND
RESERVOIR

STAGE HYDROGRAPH
FOR FAILURE AT
NORMAL HIGH POOL ELEVATION

PLATE D-12